AGREEMENT FOR GRADING CONTRACT.

Whereas, The American Construction Company, a company organized and existing under the laws of New Jersey, and hereinafter called the Construction Company, has heretofore, to wit, upon the day of August, 1883, made and entered into a certain contract with The South Pennsylvania Railroad Company, a corporation organized and existing under the laws of Pennsylvania, and hereinafter called the Railway Company, to build, construct and complete the entire line of the railroad of the said Railway Company, from the east bank of the Susquehanna River to the west bank of the Youghiogheny River, in the State of Pennsylvania, to which contract reference is hereby made, these presents being made in subordination to the terms thereof;

And whereas, The construction and completion of said railroad is desired within a period too short to permit the whole of the said work to be performed by the said Construction Company, which desires to sublet certain portions thereof;

Now, therefore, This agreement, made this day of in the year of our Lord one thousand eight hundred and eighty- between party of the first part, hereinafter called the Contractor, and the said The American Construction Company, party of the second part, witnesseth:

I. That for and in consideration of the prices, payments and covenants herein mentioned to be paid, made and performed by the Construction Company, the Contractor hereby covenants and agrees to construct and finish in a substantial and workmanlike manner, to the satisfaction and acceptance of the Chief Engineer and Directors of the said The South Pennsylvania Railroad Company, and in strict conformity with the annexed specifications, hereby adopted, accepted and declared by the parties hereto to be an essential part of this agreement, the following described work upon the established line of the said Railway Company, and upon the final location thereof in the County of in the State of Pennsylvania, viz.:

And it is mutually agreed between the said parties of the first and second parts, that:

Right of way.—1. The right of way and the use of such lands as may be necessary to enable the said Contractor to conform to the requirements of the specifications hereto attached, shall be furnished for the construction of the said railroad by the said Construction Company, so that the work herein contracted for can be promptly commenced and prosecuted to completion.

Work Executed under Direction of Chief Engineer.—2. The work shall be executed under the supervision and direction of the said Chief Engineer of the Railroad Company (hereinafter called the Chief Engineer), who shall designate the portions of the line upon which work shall be done, and who shall, at all proper times, furnish plans, measurements, stakes and directions for doing the work; and his classification of materials, measurements and estimates shall be final. Oral instructions in regard to any work to be performed under this agreement, if accepted by the said Contractor, shall be accepted at his own risk, and no instructions so given will relieve the said Contractor from liability to damages or expenses arising from the performance of the work, in accordance with such instructions, or in any other way than in accordance with this agreement, and the said Construction Company hereby reserves to itself the right to accept or reject any or all work done in accordance with such instruction.

Tools, Materials, Mechanics, Laborers, etc., at Contractor's Expense.—3. The said Contractor shall, at his own expense, cost and charge, find and provide a full and ample supply of the best and most suitable tools and appliances required to be used in the performance of the said work, and to provide the best of materials of every kind that may be needed for the thorough and expeditious execution of said work, and shall furnish and provide in sufficient numbers all mechanics, laborers and other workmen, and also all things that may be necessary and requisite for constructing and completing, within the time herein stipulated, the whole of the work herein agreed to be done.

Contract to be Completed.—4. The work herein contracted for shall be commenced within twenty days after the date of this agreement, and shall be completed on or before the first day of A. D., 188 .

Prices.—5. For and in consideration of the true and faithful performance, by the said Contractor, of the agreements and conditions contained in this agreement and the specifications hereto attached, the said Construction Company hereby promises and agrees to pay to the said Contractor, his executors or administrators, for the work done and materials furnished as aforesaid, at the following rates and prices, to wit:

For Clearing, per acre	$	Cts.
" Grubbing, "		

GENERAL EXCAVATION.

For Solid Rock, per cubic yard	$	Cts.
" Loose " "		
" Hard Pan, " "		
" Earth, " "		

EXCAVATION IN WATER.

For Solid Rock, per cubic yard	$	Cts.
" Loose " "		
" Hard Pan, " "		
" Earth, " "		

TUNNEL EXCAVATION.

For Tunnels, single track, per cubic yard	$	Cts.
" " double " " "		
" Shafts, " "		

BALLAST.

For Broken Stone, per cubic yard	$	Cts.
" Gravel, " "		

MASONRY.

For First-Class, per cubic yard	$	Cts.
" Second " "		
" Third " and Box Culvert, in cement, per cubic yard		
" Third-Class and Box Culvert, dry, per cubic yard		
" Arch Masonry, first-class, per cubic yard		
" " " second-class, in cement, per cubic yard		
" Arch Masonry, second-class, dry, per cubic yard		
" Slope Walls, per cubic yard		
" Stone Paving, in cement, per cubic yard		
" " " dry, " "		
" Concrete, " "		
" Brick Work, " "		
" Packing, in cement " "		
" " dry, " "		
" Rip Rap, " "		

DRAIN PIPE.

For 12-inch, per lineal foot	$	Cts.
" 15 " " "		
" 18 " " "		

FOUNDATION TIMBER.

For White Oak, per 1,000 ft., B. M.	$	Cts.
" Hemlock, " " "		

TRESTLE TIMBER.

For White Oak, per 1,000 ft., B. M.	$	Cts.
" Hemlock, " "		

TUNNEL TIMBER FOR PERMANENT SUPPORTS.

For White Oak, per 1,000 ft., B. M.	$	Cts.
" Hemlock, " " "		

PILING.

For White Oak, per lineal foot	$	Cts.
" Hemlock. " "		

IRON WORK.

For Wrought, per pound	$	Cts.
" Cast,		

SUPPLEMENTAL.

TUNNEL WORK.

For single track, with arch, per lineal foot, completed	$	Cts.
For single track, with arch and side walls, per lineal foot, completed	$	Cts.
For single track, without masonry, per lineal foot, completed	$	Cts.
For double track, with arch, per lineal foot, completed	$	Cts.
For double track, with arch and side walls, per lineal foot, completed	$	Cts.
For double track, without masonry, per lineal foot, completed	$	Cts.

Monthly Estimates and Payments.—6. During the progress of said work, so long as the terms of this agreement shall be complied with by the said Contractor, the said Construction Company shall make payments to said Contractor, on or about the fifteenth day of each month, for the work done during the previous month, said work to be estimated and certified to by the said Chief Engineer to be in accordance with this agreement, less, however, a reservation of fifteen (15) per cent. thereof, which shall remain in the hands of said Construction Company as an agreed compensation for damages, to be retained forever by the said Construction Company, in case the whole work herein contracted to be performed is not done in accordance with this agreement; provided that a larger and sufficient amount may, at the discretion of the said Chief Engineer, or the Directors of the said Railway Company, be retained to protect the said Construction Company against the overpayment for work done, as compared with that remaining to be done, it being, however, expressly understood that it will be wholly discretionary with the said Construction Company to make any payments on account of materials delivered, and not permanently applied to the work for which they may have been intended.

Final Estimate and Payment.—7. When this agreement shall have been completely performed on the part of the said Contractor, the said Chief Engineer shall make a final estimate of the quantity, quality and value of the work done, according to the terms of this agreement, and the said Construction Company shall, within ninety (90) days thereafter, pay to the said Contractor, upon his giving a release under seal to the said Construction Company from all claims or demands whatsoever growing in any manner out of this agreement, all sums of money then remaining due and unpaid upon the work performed under this agreement, after first deducting therefrom any and all sums herein provided to be retained by the said Construction Company.

Chief Engineer Not to Be Bound by Previous Estimates.—8. In computing the said final estimate, and giving his final certificate, the said Chief Engineer shall not be bound by any preceding estimates and certificates, but such preceding estimates and certificates shall be held to be only approximative to the final estimate, and the said monthly estimates and certificates on unfinished work shall in no case be taken as an acceptance of the work, or a release of the said Contractor from responsibility therefor, until the final estimate is made and the work in its entirety is accepted as complete under this agreement.

II. And it is further distinctly understood and agreed:

Sub-Contracts.—1. The said Contractor shall not assign or sublet the whole or any part of this agreement (excepting only for the supply of materials and plant), without having first obtained the consent in writing of the said Construction Company thereto.

Action in Case of Non-Performance of Contract. 2. If at any time during the progress of the work, it should appear by report of the said Chief Engineer that the force employed, the quantity or quality of the tools, appliances or workmen provided, or that the progress or character of the work, or materials furnished, are not respectively such as, in the opinion of the said Chief Engineer, will insure the completion of the work under this agreement, within the time stipulated, or are not in accordance with the specifications annexed hereto, then, and in that case, the said Construction Company may serve written notice on the said Contractor to at once supply such increase of force, appliances or tools, and to cause such improvement in the character of the work or materials to be made, as may be required to make the same conform to the stipulations of this agreement and specifications; and if, on the expiration of ten (10) days after the service of such written notice upon the said Contractor, personally or by leaving the same at his office or last known place of residence, the said Contractor shall have failed to furnish to the said Construction Company satisfactory evidence of his efforts, ability and intention to furnish the desired improvements and remedy the specified deficiencies, the said Construction Company may thereupon enter on and take possession of the said work, or any part thereof, with the tools, material, plant, appliances, houses, machinery and other appurtenances thereon, and hold the same as security for any or all damages or liabilities that may arise by reason of the non-fulfillment of this agreement within the time herein stipulated; and furthermore, may employ the said tools, materials, etc., as aforesaid, and such other means as the said Construction Company may deem proper to complete the work, at the expense of the said Contractor, and may deduct the cost of the same from any payments then due, or thereafter falling due, to the said Contractor; and in case the said Contractor shall not complete the said work within the time herein specified, and the said Construction Company shall, notwithstanding such failure, permit the said Contractor to proceed with or complete the said work as if such time had not elapsed, such permission shall not be deemed a waiver in any respect, by the said Construction Company, of any forfeiture or liability for damages, or expenses thereby incurred, arising from such non-completion of the said work within the time specified, but such forfeiture or liability shall still continue in full force against the said Contractor, as if such permission had not been granted. And it is further distinctly understood and agreed that time, whenever involved in this agreement, is of the essence of this agreement.

Action in Case of Non-Payment of Wages.—3. In all cases of non-payment by the said contractor of any sum or sums of money due the laborers or other workmen, for work performed under this agreement, the said Construction Company is hereby authorized to pay such laborers or workmen the amounts due and owing to them by the said Contractor; and if any action or proceeding at law or in equity shall be instituted, by virtue of any law or statute now in force, or hereafter enacted, for labor and wages on said work, the said Construction Company may pay all damages, wages, recoveries, costs, expenses, and counsel fees arising therefrom, and deduct the same, and also what amounts may be paid for wages as before mentioned, from any moneys due or to grow due to the said Contractor; and the said Construction Company may, from time to time, retain such reasonable sums as it may deem necessary for its protection in this behalf, and the said Contractor shall pay the deficiency arising therefrom upon demand.

Incompetent or Riotous Employés.—4. The said Contractor shall discharge any foreman or other employé who shall, in the judgment of the said Chief Engineer, be unfaithful, unskillful, or remiss in the performance of his work, or guilty of riotous, disrespectful, or otherwise improper conduct; and no person so discharged upon this work, or any other work done for the said Construction Company, shall be employed again by the said Contractor, upon the work to be done under this agreement, without the written consent of the said Chief Engineer.

Intoxicating liquors.—5. The use or sale of ardent spirits or other intoxicating beverages upon the work, or in any of the buildings, boarding houses, or other tenements owned, occupied or within the control of the said Contractor or any of his employés, is strictly forbidden, and the said Contractor shall exercise his influence and authority to their utmost extent to secure compliance with this regulation.

Responsibility for Violation of Laws and Injury to Persons or Property.—6. In all operations connected with the work embraced in this agreement, the said Contractor shall be held responsible for any failure to respect, adhere to, and comply with, all local ordinances and laws controlling or limiting, in any way, the actions of those engaged upon the work, or affecting the materials, or the transportation or deposition of them. And the said Contractor hereby assumes all liability for, and agrees to indemnify the said Construction Company against all loss, cost or damages for or by reason of any liens, claims or demands for materials, or from laborers, mechanics and others, and from any damages arising from injuries sustained by mechanics, laborers or other persons, by reason of accidents or otherwise, and from damages sustained by depositing materials to public injury, or the injury of any person or corporation, including costs and expenses of defense, provided that he be duly notified of the bringing of suits in such cases, and be permitted to defend the same by his own counsel if he should so elect.

Temporary Fences and Roadways.—7. Where the line of the railroad passes through farms, the said Contractor shall keep up such temporary fences as may be necessary for the preservation of the crops thereon. The said Contractor shall be responsible for any damages that may be done by him or his workmen, during the performance of this work, to property adjacent to the line, in consequence of his or their unskillfulness or negligence; and if any such damage shall be done, the said Chief Engineer shall have the right to settle and pay the same, and deduct the amount thereof from the payments to be made upon his estimates. Whenever any work herein embraced shall in any manner interfere with a public or private traveled road, the said Contractor shall keep a temporary roadway, during such interference, at all times unobstructed and safe for travel, and any damages which may result from failure so to do, may be settled and withheld as above, until paid by the said Contractor.

Extra Work.—8. If any work should be required to be done by the said Construction Company, which is not now contemplated or provided for in this agreement and specifications, the said Chief Engineer shall fix the price for the same, and the said Contractor shall abide by such price, provided it be not less than the contract price for such class of work.

Chief Engineer may Alter Line, Location, etc.—9. The said Chief Engineer shall have the right to make any alterations that may be hereafter determined upon by him as necessary or desirable in the location, line, grade, plan, form or dimensions of the work, either before or after the commencement of the same, defining them in writing, and by or without drawings; and in case such alterations increase the quantities, the said Contractor shall be paid for such excess at the contract rates herein specified; but should such alterations diminish the quantity or extent of the work to be done, they shall not, under any circumstances, be construed as constituting, and shall not constitute, a claim for damages, nor shall any claim be made on account of anticipated profits on the work that may be altered or dispensed with, the intent of this provision being that only the work absolutely done shall be paid for, and at the prices named in this agreement.

Claim for Extra Work.—10. No claim for extra work shall, under any circumstances, be made, allowed or considered, unless the same shall have been done in pursuance of an order given in writing by the said Chief Engineer, but nothing shall be deemed or construed as extra work which can be classified, measured and estimated under the terms of this agreement.

Allowance for Delays.—11. No extra compensation shall be made to the said Contractor for hindrances or delays from any cause in the progress of any portion of the work performed under this agreement; but if such delays or hindrances arise from any cause other than the fault of the said Contractor, then, and in that case, the said Contractor shall be entitled to such an extension of time for the completion of his contract as shall, in the opinion of the said Chief Engineer, be sufficient to compensate for any such detention, provided the said Contractor shall give notice, in writing, to the said Construction Company of such hindrances and delays, stating the cause thereof, within twenty-four hours after the same shall first occur.

Right to Suspend Work.—12. The said Construction Company reserves the right to suspend or terminate the work embraced in this agreement for reasons not herein specified, and the said Contractor hereby agrees to discontinue all work within ten days after receiving notice of such suspension or termination, in which case the said Contractor shall be entitled to payment in full for all materials actually handled or supplied, but shall make no claim for consequential damages or anticipated profits upon work not actually performed, or damage of any kind resulting from such suspension or termination.

Repairs in Case of Defective Work.—13. Any replacements or repairs rendered necessary upon or about the work herein contracted for, by reason of defective material or workmanship furnished or performed by the said Contractor, shall be made by the said Contractor upon demand, without cost or expense to the said Construction Company.

Chief Engineer to Settle Disputes.—14. All questions, differences or controversies which may arise between the parties hereto in regard to any work to be done under this agreement, whether as to its performance or non-performance, or in any way whatever pertaining to or connected with the said work, shall be referred to the said Chief Engineer, and his decision shall be in the nature of an award, and be final and conclusive upon both parties, unless the same shall be reversed or modified by the Board of Directors of the Railway Company upon appeal by either party.

In witness whereof, the said Construction Company has caused its corporate seal to be hereunto affixed, and these presents to be signed by its President and attested by its Secretary, and the said Contractor has hereunto set his hand seal the day and year first above written.

President of the American Construction Company.

Attest:

Secretary of the American Construction Company.

Witnesses.

_____ _____ [L. S.]

_____ _____ [L. S.]

_____ _____ [L. S.]

_____ [L. S.]

Contractor.

State of.....
.....of.....
County of..... } ss.:

On this day of 188 , before me personally appeared to me known to be the person described in and who executed the foregoing agreement, and acknowledged that exe-cuted the same.

SPECIFICATIONS FOR GRADING.

Grading.—Under this head shall be included clearing and grubbing, all open excavations, tunnels and embankments required for the foundation of the road-bed, turn-outs, sidings and station grounds, cutting all ditches about or contiguous to the road, masonry, foundation pits, planking, piling, pumping, bailing, changing of water courses, the reconstruction of mill races, highways and by-ways in cases where they are interfered with or destroyed in the formation of the railroad, and all excavations and embankments in any way connected with or incident to the construction of the said railroad.

Clearing.—The lands of the said Railway Company shall be cleared, to the extent required by the said Chief Engineer, of all trees, bushes, logs, and other perishable materials, which shall be destroyed by burning, or deposited in heaps, as the Chief Engineer may direct. Large trees must be cut not more than two and one-half (2½) feet from the ground, and under embankments less than four (4) feet high they shall be cut close to the ground. All small trees and bushes shall be cut close to the ground.

Clearing shall be estimated and paid for by the acre or fractions of an acre.

Grubbing.—All stumps, roots, logs and other obstructions shall be grubbed out and removed from all places where embankments occur less than two (2) feet in height; also from all places where excavations occur; and from such other places as the Chief Engineer may direct.

Grubbing shall be estimated and paid for by the acre or fractions of an acre.

Excavations.—Excavations shall be classified under the following heads, viz.: Solid Rock, Loose Rock, Hard Pan, Earth, and Excavation in Water.

Solid Rock.—Solid rock shall include all rock found in ledges, and detached masses exceeding one (1) cubic yard, each, which, in the judgment of the said Chief Engineer, may be best removed by blasting.

Loose Rock.—Loose rock shall include all kinds of shale, soapstone and other rock which, in the judgment of the said Chief Engineer, can be removed with pick and bar; also detached stones of less than one (1) cubic yard and more than one (1) cubic foot.

Hard Pan.—Hard pan shall consist of tough, indurated clay, or cemented gravel, which requires blasting, or other equally expensive means for its removal, or which cannot be plowed with less than four horses and a railroad plow, or which requires two pickers to a shoveler, the said Chief Engineer to be the judge of these conditions.

Earth.—Earth shall include all materials of an earthly nature, of whatever name or character, not unquestionably Rock or Hard Pan, as above defined.

Excavation in Water.—Excavation in water shall apply to foundation pits under water and deepening of channels in running water; it must include drainage, bailing, pumping, and all materials and labor connected with such excavations; also the necessary dressing of the rock for base course of masonry. The materials removed from excavations in water shall be classified and determined in the same manner as materials removed from other classes of excavations, viz.: as Solid Rock, Loose Rock, Hard Pan and Earth.

Embankments.—Embankments shall be of such dimensions and slope as the said Chief Engineer may direct; they shall be made in accordance with his instructions, and of materials which, in his judgment, are suitable; they shall be carried to such height above grade as the said Chief Engineer may deem necessary to provide for shrinkage, compression, washing, drainage and settlement, and they must be maintained to their proper height, width and shape until accepted by the said Chief Engineer. No large stones will be allowed within a depth of at least two (2) feet below grade, and the best materials must in all cases be reserved for finishing and dressing the surfaces. Whenever the embankment is made from side ditches, such ditching and the crest of the slopes thereof shall in no case approach within ten (10) feet, nor within double the depth of the ditch of the foot of the embankment slopes, and the slope of the excavation next to the embankment shall not be steeper than the slope of the embankment. The width of berme left at the foot of the slopes shall in all cases be such as the said Chief Engineer may direct. Whenever new water courses or channels for rivers or streams are required to be formed, they shall be put at such distance from the foot of the slopes as the said Chief Engineer may direct,

No perishable materials will be allowed in embankment; all proper materials taken from the excavations on the line of the railroad shall be moved into embankments, and shall be measured only as excavation, and, when directed by the said Chief Engineer, all surplus materials shall be used in widening embankments, in such manner as he shall direct.

Embankments about masonry shall be built at such times and in such manner and of such materials as the said Chief Engineer may direct.

Embankments at Bridges and Culverts.—Embankments shall not be carried forward in the usual way within fifty (50) feet of any piece of masonry finished or in progress, counting from the bottom of the slopes, but, in every such case, the earth shall be wheeled to the walls or abutments, and carefully rammed to such width and depth and in such manner as the said Chief Engineer may direct, when the embankment may carried on as usual. For the work of wheeling and ramming efficiently the earth around any piece of masonry an additional price shall be paid, to be fixed by the said Chief Engineer.

Borrow Pits and Spoil Banks.—In all cases where the excavations are insufficient to make the embankments, the deficiency shall be supplied by widening excavations, or from borrow pits, to be furnished by the said Construction Company, as the said Chief Engineer may direct, and all such borrow pits shall be drained and sloped as the said Chief Engineer may direct.

Any surplus rock and earth taken from the excavations, not required for embankments, masonry, rip rap, ballast, or other purposes, may, at the discretion of the said Chief Engineer, be deposited in a regular manner on either side of the excavation in such a manner as to intercept the drainage of surface water from flowing into the road-bed and side ditches, leaving a berme of not less than ten (10) feet between the spoil bank and the top line of the excavation slopes; but spoil banks in embankments shall in no case be raised above the grade level of the road-bed.

All materials taken from excavations which, in the judgment of the said Chief Engineer, may be of greater value to the said Construction Company for other purposes than embankments, and also all timber removed from the line of the railroad, shall be considered the property of the said Construction Company, and shall be deposited in convenient positions, under the direction of the said Chief Engineer.

Ditches.—In clay cuts ditches shall be dug along the foot of the slope, of such dimensions as the said Chief Engineer may direct. To protect the cuts from washing, ditches shall be dug above the cutting, upon ground sloping toward the cuts, and connected with the embankment ditches, when directed by the said Chief Engineer; and if the material from such ditches is wasted, it shall be deposited between the ditch and the cut. Ditches shall also be dug in other places and for other purposes, when so directed by the said Chief Engineer.

Measurement of Excavations.—Materials shall be measured in excavations whenever possible, and the term "Excavation" shall include all cuttings, borrow pits, roadways, changes of water courses, ditches, foundation and trestle pits, and, in fact, every kind of excavation at any time required. Wherever the excavations are left in such shape that they cannot well be measured, the said Chief Engineer may measure the materials in embankment; but in such case he shall deduct from the amount actually measured ten (10) per cent. for wheel-barrow and shovel work, and five (5) per cent. for scraper and team work, to cover loss from shrinkage when measured before the embankment has had time to settle.

Excavation, How Estimated and Paid For.—Excavation, in all the several classes thereof, shall be of such dimensions and slope as the said Chief Engineer may direct, and shall be estimated and paid for by the cubic yard.

Over Haul.—The price paid for excavation, in all the several classes thereof, shall be understood to cover and pay for the entire expense of its removal by any method whatever, including loading, unloading, transportation to and deposit, in the manner prescribed in these specifications, in the places designated by the said Chief Engineer, provided the necessary haul of the material so transported does not exceed one thousand (1,000) feet; beyond that distance, one (1) cent per cubic yard per one hundred (100) feet shall be allowed and paid for such necessary extra haul.

Ballast.—When so directed by the said chief engineer, the said Contractor shall be required to ballast the entire length of his section or sections one (1) foot deep above the grade, neatly and truly leveled, and lined up to such widths and end slopes as the said Chief Engineer may prescribe. The material shall be either gravel or broken stone.

Gravel must be clean, free of clay, earth, loam and stones larger than will pass through a two and one-half (2½) inch ring in any direction; it must not contain more than one-third (⅓) sand, and shall be subject to the inspection and acceptance of the said Chief Engineer.

Broken stone must be of good, hard, durable stone, selected by the said Chief Engineer, and must be broken or crushed into fragments not larger than will pass through a two and one-half (2½) inch ring in any direction, and be perfectly clean and free from all dirt, or any other earthy admixture, before being spread on the road-bed.

Stone ballast shall under no circumstances be allowed to be broken in place on the road-bed, but must be broken in clean places, specially prepared for that purpose, and laid up in piles, to be hauled and spread on the road-bed, after the grade surface has been prepared for it.

When good material for ballast is found in the excavations on the line of the railroad, and does not require breaking, the said Chief Engineer may require the road-bed to be raised one (1) foot above grade with this material, and the said Contractor shall be paid for the material so handled at the same rates as for excavation of material of the same class.

Ballast shall be estimated and paid for by the cubic yard, and the price paid shall include hauling, placing and spreading, as herein directed.

MASONRY.

All stone used for the different classes of masonry must be secured by the said Contractor, and must be sound, durable and not liable to be affected by the weather, and shall be subject to the approval of the said Chief Engineer.

Masonry shall be classified as follows, viz.:

First-Class Masonry.—First-class masonry shall consist of range rock work of the best description. The face stones shall be accurately squared, jointed and bedded, and laid in regular horizontal courses of not less than ten (10) inches in thickness, decreasing in thickness regularly from the bottom to the top of the walls. They will consist of headers and stretchers, and there shall be at least one (1) header to every two (2) stretchers, and they shall be so laid that, as nearly as practicable, the headers in each course shall divide equally, or nearly so, the space between the headers in the course immediately below.

Stretchers shall be not less than three (3) ft. in length and eighteen (18) in. in width.

Headers shall be not less than three (3) ft. in length and eighteen (18) in. in width, and shall hold the size back into the heart of the wall that they show in its face.

When the walls do not exceed four (4) ft. in thickness the headers shall run entirely through, and when they exceed that thickness there shall be as many headers of the same size in the rear as in the front of the wall, so arranged that a header in the rear of the wall shall be between two headers in the front.

Every stone must be laid on its natural bed, and all stones must have their beds well dressed and made always as large as the stone will admit of. Mortar joints shall not exceed one-half (½) in. in width; the vertical joints of the face must be in contact at least four (4) in., measured in from the face, and as much more as the stone will admit of. All corners and batir lines must be run with a neat chisel draft of one and one-half (1½) in. on each corner, and the projections of the rock face must not exceed three (3) in. beyond the face or draft lines of the stones. In tunnel side walls this projection must not exceed two (2) in. The stones of each course shall be so arranged as to form a proper bond with the stones of the underlying course, and a bond of less than one (1) ft. shall in no case be allowed. The whole of the masonry shall be laid in cement mortar, each stone being carefully cleaned and dampened before setting, and each course shall be thoroughly cemented before the succeeding course is laid. No hammering on the wall will be allowed after the course is set. If any inequalities occur they must be carefully pointed off.

Backing.—The backing shall consist of stones with beds dressed to one-half (½) an in., and of a thickness not less than one-half (½) that of the corresponding face stones. They shall be laid in full cement mortar beds, so as to break joints and thoroughly bond the work in all directions, and on the completion of each course the spaces between the larger backing stones—none of which spaces shall be over six (6) in. wide—shall be filled with small stones and spalls thoroughly bedded in cement.

Foundation Courses.—All foundation courses must be laid with selected large, flat stones, not less than twelve (12) in. in thickness, nor of less superficial surface than fifteen (15) sq. ft.

Coping Courses.—All bridge seats and tops of walls shall be finished with a coping course of such dimensions and projection as may be ordered by the said Chief Engineer, dressed and cut to a true surface on top and on the showing faces, in conformity with diagrams for the same, which shall be furnished by the said Chief Engineer.

Second-Class Masonry.—Second-class masonry shall consist of broken or random range rock work of the best description. The face stones shall be dressed to a uniform thickness throughout before being laid, but not hammered, and shall be laid with horizontal beds and vertical joints on the face. And no stone shall be less than eight (8) in. in thickness, unless otherwise directed by the said Chief Engineer. There shall be at least one (1) header to every three (3) stretchers, and both headers and stretchers shall be of similar size, when the thickness of the wall will admit, but neither shall be less than three (3) ft. in length and fifteen (15) in. in width. The same arrangement of headers shall be required as is specified for first-class masonry. Mortar joints shall not exceed three-quarters (¾) of an in. in thickness. All corners and quoins shall have hammer-dressed beds and joints. All corners and batir lines shall be run with an in. and one-half chisel draft. The vertical joints of the face must be in contact at least four (4) in., measured in from the face, and as much more as the stone will admit of.

The work need not be laid up in regular courses, but shall be well bonded. The stones shall be cleaned and dampened before setting and shall be laid in cement mortar.

Backing.—The backing shall consist of stones not less than six (6) in. thick (at least one-half (½) of which shall measure two (2) cubic ft.), laid in full cement mortar beds, with good joints and bonds, and the spaces filled with spalls thoroughly bedded in cement, as specified for first-class masonry.

Coping Courses.—Bridge seats and tops of walls shall be coped in the same manner as specified for first-class masonry.

Foundation Courses.—Stones in foundation courses shall be of not less than twelve (12) in. in thickness and ten (10) sq. ft. of surface.

Third-Class and Box Culvert Masonry—Third-class masonry shall be laid dry, or in lime or cement mortar, according to the direction of the said Chief Engineer.

It shall be formed of good quarry stones, laid upon their natural beds, and roughly squared on the joints, beds and faces, the stones breaking joints at least six (6) in., and with at least one (1) header for every three (3) stretchers. No stones shall be used in the face of the wall less than six (6) in. thick or less than twelve (12) in. on the least horizontal dimension. Headers shall be at least three (3) ft. long, or extend entirely through the wall. The ends of all walls shall be dressed, and either stepped to correspond with the slope of the embankment or finished with a cross-head wall, as the said Chief Engineer may direct.

Foundation.—The stones in the foundations must be not less than ten (10) in. in thickness, and shall contain not less than ten (10) sq. ft. of surface, and each shall be firmly, solidly and carefully laid.

Box Culverts.—In box culverts the top course shall extend entirely across the wall and the covering stones shall have a bearing of at least one (1) ft. on each wall. The covering stones shall be not less than ten (10) in. thick for two (2) ft. culverts, than twelve (12) in. thick for three (3) ft. culverts, or than fifteen (15) in. thick for four (4) ft. culverts. When covering stones cannot be obtained the said Chief Engineer may require a rubble arch to be substituted for it, which shall be paid for at the same rate as other third-class masonry.

Drain Pipe.—In localities where but a small quantity of water passes drain pipe shall be substituted for culverts when so ordered by the said Chief Engineer. Sizes of twelve (12) in., fifteen (15) in. or eighteen (18) in. diameter to be used as directed by the said Chief Engineer, and the quality must be the best of Scotch vitrified pipe, or if other kinds are used must be in quality fully equal in every respect to the Scotch, and be subject to the approval of the said Chief Engineer. Drain pipe shall be estimated and paid for by the lineal ft. Drain pipes must be well and carefully bedded and laid, and in accordance with the instructions of the said Chief Engineer.

Arch Masonry, First-Class.—Arch masonry, first-class, shall be laid in cement mortar, and shall be built in accordance with the specifications for first-class masonry, when and to the extent that the said Chief Engineer may direct.

Ring Stones and Arch Sheeting Stones.—The ring stones shall be dressed to such size and shape as the said Chief Engineer shall determine. The ring stones and arch sheeting stones shall be of not less thickness than ten (10) in. on the intrados of the arch, and shall be dressed with three-eighths (⅜) in. joints, and shall be of the full depth specified by drawings or otherwise for the thickness of the arch. The joints must be made on truly radial lines, and the face of the sheeting stones must be dressed to make close joints. The ring stones and arch sheeting stones shall break joints not less than one (1) ft.

Wing Walls.—The wing walls shall be neatly stepped, in accordance with the drawings furnished, with selected stones the full width of the wing and not less than ten (10) in. thick, and no stone shall be covered less than eighteen (18) in. by the one next above it. The wing walls may be finished with a neatly capped newel at end of wing, and a string coping course on the wing when so decided by the said Chief Engineer.

Parapets.—The parapets shall be finished with a coping course of full width of parapet, with such projection as may be directed by the said Chief Engineer, the stone to be not less than ten (10) in. in thickness.

Arch Masonry, Second-Class.—Arch Sheeting Stones.—Arch masonry, second-class, shall be laid in cement mortar, or dry, as the said Chief Engineer may direct, and shall be of the same general character and description as second-class masonry, with the exception of the arch sheeting, for which proper stones shall be selected that shall have a good bearing throughout the thickness of the arch, and shall be well bonded and be of the full depth of the arch. No stone shall be less than six (6) in. in thickness on the intrados of the arch.

Ring Stones—The ring stones of all arches shall conform to the specifications for first-class arch masonry.

Retaining Walls.—Retaining walls shall be classified as second or third-class masonry, laid dry, as may be ordered in each particular case.

Slope Walls.—Slope walls shall be of such thickness and slope as directed by the said Chief Engineer. The stones must reach entirely through the wall, and be not less than four (4) in. thick and twelve (12) in. long; the joints must be close and free from spalls. The foundations must be prepared and laid as directed by the said Chief Engineer.

Stone Paving.—Stone paving for culverts and other water courses shall be made by setting stone from eight (8) to fifteen (15) in. deep on edge, laid either dry or in strong cement mortar, as may be directed by the said Chief Engineer.

Rip Rap.—When required by the said Chief Engineer, the said Contractor shall protect the face of embankments, or the foot of slopes, from the action of water by a facing of rip rap of stone, or of brush and stones, or by a retaining wall, as may be directed. The rip rap, when used, shall be laid by hand, by competent workmen, and shall be of such thickness and slope and of such ordinary stone as the said Chief Engineer may direct.

Brick Masonry.—Brick masonry must be laid with the best quality of all hard burned brick, well tempered and molded to standard size. No bats, cracked, crooked, or salmon bricks, under any circumstances, will be allowed in the work. The bricks shall be we well soaked in water before being laid, and shall be laid in the best hydraulic cement mortar, with such thickness of joint and style of bond as shall be prescribed by the said Chief Engineer.

Grout.—Grout shall be substituted for mortar when ordered by and to such an extent as may be desired by the said Chief Engineer.

Brick Arching—Keying of Arches—Packing.—Brick arching must be coated on the back with a coating of strong cement mortar one (1) in. in thickness; and in tunnel arching, wherever a seam of water is met, the arch must be covered over with roofing felt, or a course of asphaltum applied hot, of such thickness as may be directed by the said Chief Engineer, and this covered again with plastering of cement mortar, so as to make the arch impervious to water, a drainage channel properly formed being left for it in the backing of the arch and side walls, with suitable openings left for its escape at such points and of such size as may be directed by the said Chief Engineer. Where roofing felt or asphaltum is ordered by the Chief Engineer to be used, a price shall be fixed by him for the same. The keying of all arches shall be most carefully done, in such manner as may from time to time be directed by the said Chief Engineer. The packing between the arch and tunnel roof, over any section of the arch, shall never be done until the section has had at least forty-eight (48) hours for setting after being keyed.

Price to Cover What.—The price per cubic yard for masonry and brick work shall include the furnishing of all materials, scaffolding, centering and all other expenses necessary to the construction and completion of the masonry or brick work, and the maintenance of the same until the work is accepted.

Cement.—Cement must be of the best quality of freshly-burned and ground hydraulic cement, and be equal in quality to the best brands of "F. O. Norton's cement." It shall be subject to test made by the said Chief Engineer, or his appointed inspector, and must stand a proof tensile test of fifty (50) lbs. per sq. in. of sectional area on specimens allowed a set of thirty (30) minutes in air and twenty-four (24) hours under water.

Cement Mortar.—Cement mortar shall in all cases be made of one (1) part in bulk of the best hydraulic cement to two (2) parts in bulk of clean, sharp sand, well and thoroughly mixed together in a clean box of boards before the addition of the water, and must be used immediately after being mixed. No mortar left over night will, under any pretext, be allowed to be used. The sand and cement used shall at all times be subject to inspection, test, acceptance or rejection by the said Chief Engineer.

Lime Mortar.—Lime mortar (which in all cases shall contain cement) shall consist, unless otherwise directed by the said Chief Engineer, of two parts of best quicklime, one of cement and five of sand; the ordinary mortar of lime and sand being first properly made, and the cement thrown in and thoroughly mixed before using.

Concrete.—Concrete shall be composed of fragments of hard, sound and acceptable stone, broken to a size that will pass through a two (2) in. ring in any direction, thoroughly clean and free from mud, dust, dirt or any earthy admixture whatever; mixed in the proportion of three (3) parts in bulk of the broken stone to one (1) part of freshly made cement mortar of the quality herein described. The broken stone is to be well watered and the stone and mortar thoroughly turned and mixed on a tight plank floor immediately before using, until every stone is coated with the mortar; concrete is to be quickly laid in sections and in layers not exceeding nine (9) in. in thickness, and to be thoroughly rammed until the mortar flushes to the surface; it shall be allowed at least twelve (12) hours to set before any work is laid on it. Concrete may be substituted for masonry in foundations and backing and arch culverts when so ordered by the said Chief Engineer.

Pointing.—The showing joints of all classes of masonry laid in cement must be neatly pointed with cement mortar, finely tempered; but the pointing of joints that have no existence will not be allowed.

General Provisions.—Brick masonry may at all times be substituted for stone when so ordered by the said Chief Engineer.

No masonry of any kind must be covered up until it has been inspected and accepted by the said Chief Engineer.

All masonry shall be built according to the plans and instructions furnished by the said Chief Engineer, and the several classes thereof shall be estimated and paid for by the cubic yard, computing only the actual solidity thereof required by the plans and layout.

No constructive or conventional measurement will be allowed, any rule or custom in the section of the country through which the road passes to the contrary notwithstanding.

All materials shall be subject to rigid inspection, and any that have been condemned must be removed from the site of the work immediately. No masonry will be allowed to be laid in freezing weather. All masonry shall be subject to the supervision of an inspector, whose duties shall be to see that the requirements of these specifications are conformed to, but his presence is in no way to be presumed to lessen in any degree the responsibility of the said Contractor or his obligations.

No allowance will be made for timber, or work on same, used in scaffolding, shoring or centering for arches, excepting only timber furnished for sheet piling, or foundation timbers or plank, necessarily, and by order of the said Chief Engineer, left in the ground.

FOUNDATIONS.

General Description.—Foundations for masonry shall be excavated to such depths as may be necessary to secure a solid bearing for the masonry, of which the said Chief Engineer shall be the judge. The materials excavated shall be classified and paid for, as provided for in these specifications, under the general head of Excavations; and in case of foundations in rock, the rock must be excavated to such depth and in such form as may be required by the said Chief Engineer, and must be dressed level to receive the foundation course.

When a safe and solid foundation for masonry cannot be found at a reasonable depth (to be judged of by the said Chief Engineer), there shall be prepared by the said Contractor such artificial foundations as the said Chief Engineer may direct. All materials taken from the excavations for foundations, if of proper quality, shall be deposited in the contiguous embankment; but any material unfit for such purpose shall be deposited outside the roadway, or in such place as the said Chief Engineer shall direct, and so that it shall not interfere with any drain or water course.

Timber—Iron Work.—Timber foundations, when required, shall be such as the said Chief Engineer may by drawings or otherwise prescribe, and shall be paid for by the one thousand (1,000) ft., board measure, the price covering cost of material, framing and putting in place. All wrought and cast iron work ordered by the said Chief Engineer shall be paid for by the pound, the price including cost of material, manufacture and placing in the work.

Piling.—All timber used in foundations or foundation piling shall be of young, sound and thrifty white oak, yellow pine, or other timber equally good for the purpose, acceptable to the said chief engineer. Piles must be at least 8 in. in diameter at the small end and 12 in. in diameter at the butt when sawn off; they must be perfectly straight and trimmed close, and have the bark stripped off before they are driven. They must be driven into hard bottom until they do not move more than ½ in. under the blow of a hammer weighing 2,000 pounds, falling 25 ft. at the last blow. They must be driven vertically, and at the regular distances apart from centers, transversely and longitudinally, as required by the plans or directions of the said Chief Engineer; they must be cut off squarely at the butt, and be well sharpened to a point, and when necessary, in the opinion of the said Chief Engineer, shall be shod with iron and the heads bound with iron hoops, of such dimensions as he may direct, which shall be paid for the same as other iron work used in foundations.

The necessary length of piles shall be ascertained by driving test piles in different parts of the localities in which they are to be used; and in case a pile shall not prove long enough to reach hard bottom, it shall be sawed off square, and a hole two (2) in. in diameter be bored into its head twelve (12) in. deep; into this hole a circular white oak treenail twenty-three (23) in. in length shall be driven, and another pile, similarly squared and bored, and of as large a diameter at the small end as can be secured, shall be placed upon the lower pile, brought to its proper position and driven as before directed. All piles, when thus driven to the required depth, are to be cut off truly square and horizontal at the proper height given by the said Chief Engineer, and only the actual number of lineal feet of the piles left for use in the foundations after being sawn off shall be paid for.

Coffer-Dams.—Where coffer-dams are, in the opinion of the said Chief Engineer, required for foundations, the prices provided in the contract for timber, piles and iron in foundations shall be allowed for the material and work on same, which are understood as covering all risks from high water or otherwise, draining, bailing, pumping and all materials connected with the coffer-dams.

Sheet piling shall be classed as plank in foundations, and shall be paid for by the one thousand (1,000) ft., board measure, if left in the ground.

TRESTLE WORK.

Trestle work shall include all wooden structures commonly used as substitutes for abutments and piers, and for farm passes, etc. These shall be built, according to the plan furnished and directions given by the said Chief Engineer, of sound, durable material, to be approved by him. The price paid shall be by the one thousand (1,000) ft., board measure, and shall be considered as in full for all material except iron, and for the labor of building and erecting complete. The iron shall be of the quality required by these specifications, and the price per pound paid shall cover all cost of material and the labor incident to its use. Spikes and nails, when used and furnished by the said Contractor shall be paid for at cost and ten (10) per cent. added.

TUNNELS.

Approach Cut.—The approach cut shall be excavated to such width and slopes as the said Chief Engineer may direct, and the materials from the cuts and the ends of the tunnels shall be placed in embankment on the line of road adjacent, or wasted, as the said Chief Engineer may direct, and they shall be classified and be paid for according to the Excavation Classification of these specifications.

Dimensions of Tunnels—Excavation—Cross-Section.—Tunnels shall be of such width and height as the said Chief Engineer may direct, and shall be excavated in conformity with the cross-section to be furnished by him. If a tunnel requires support, and timber is adopted, the area of its cross-section shall be enlarged and measured three (3) in. outside the lagging, or, if masonry is adopted, six (6) in. outside the exterior lines of the side walls and arching.

Classification and Price of Tunnel Excavations.—Materials from tunnel excavations shall be paid for by the cubic yard, or by the lineal foot, completed, in case such bid is accepted. The price paid shall cover all materials contained between the two portals, and strictly in all cases within the lines of the normal or enlarged cross-sections furnished from time to time by the said Chief Engineer, and shall include the cost of all temporary supports, such as props, scaffolding, strutting, etc., that may be necessary to secure a safe prosecution of the work in advance of the introduction of permanent supports of timbering or masonry, which temporary supports must in all cases be removed by the said contractor at his own expense after the completion of the permanent supports.

Bottoms.—The bottom shall be picked to a uniform surface and no rocky protuberances will be allowed inside the general lines of the sections.

Drainage Ditches.—The drainage ditch through the center of the tunnel, shown on the drawing of the normal cross-section, shall be carefully excavated to its full dimensions, and in it shall be laid broken stone in such manner and of such size and form as the said Chief Engineer may direct.

Shafts—Excavation Price to Cover What?—The said Chief Engineer shall determine the number and location of shafts, the dimensions of which shall be such as he may direct. The excavation price paid for them shall be by the cubic yard, and shall cover all materials contained between the surface of the ground and the soffit of the tunnel, and within the area of the cross-section furnished by the said Chief Engineer. In case the shaft is sunk alongside the tunnel, the price paid shall cover all material between the surface of the ground and the level of the foot of the shaft. The price paid shall cover the cost of such curbing or other support as the sides of the shaft may require; also whatever materials or labor may be required for ventilation and keeping the tunnel and shafts free from water, and shall also cover all hoisting and pumping machinery.

Sumps.—The excavation of all necessary wells or sumps shall be paid for at the same price per cubic yard as shaft excavation.

Average Haul, How Estimated.—In estimating the average haul of materials from shaft excavations, the vertical lift of the materials taken out from the several shafts shall be counted as part of the haul.

Niches.—Niches or openings shall be left in the walls when, and at such points as, the Chief Engineer may direct.

Falls.—Drilling and blasting shall be conducted with all possible care, so as not to shatter the roof and sides outside the section lines. Any falls that, in the judgment of the said Chief Engineer, are attributable to the carelessness or want of proper skill or attention on the part of the said Contractor, shall be removed and disposed of at his own expense; but if by unavoidable accident or natural causes, not thus attributable, any outside rock shall become loose or shattered, it shall be removed by the said contractor, and a just and equitable allowance shall be made by the said Chief Engineer to compensate and remunerate him for such removal, provided a claim for such removal be made by the said contractor during the month in which a fall so occasioned shall occur.

Permanent Supports.—Should it be determined by the said Chief Engineer during the progress of the work that any tunnel or any portion of a tunnel requires permanent supports, or that the shafts require lining, timber or brick or stone masonry may be used for such supports and lining as the said Chief Engineer may direct.

Timber.—If timber is used, the said Chief Engineer shall determine its description and quality and shall prescribe the general plan of the support, and it shall be paid for by the one thousand (1,000) ft., board measure, framed and placed in the work.

Iron Work.—All wrought and cast iron work ordered by the said Chief Engineer and used in the work shall be paid for by the pound in place.

Masonry.—When lining or arching of brick or stone masonry shall be ordered, it must be laid in the most skillful and workmanlike manner, and strictly in accordance with the plans and directions prescribed by the said Chief Engineer from time to time, to suit the necessities of the several cases as they occur.

Should it be determined to erect masonry facades at the portals of the tunnels, or to finish out above the surface any or all of the shafts with ventilators, such work shall be executed by the said Contractor in accordance with such plans and directions as may be prescribed by the said Chief Engineer for the same.

All masonry used in and about tunnels shall be classified and paid for, under the masonry classification of these specifications.

The commencement, extent and termination of all timbering and masonry shall be determined by the said Chief Engineer, and, when so determined, such timbering or masonry, as the case may be, must progress close up with the excavation, and if necessary, the excavation must be secured and protected by temporary supports, before the introduction of permanent ones.

Packing.—The vacancies behind the timber lagging or masonry walls, and above the arching, shall be filled with concrete or dry packing, as the said Chief Engineer may from time to time

direct, which packing shall be classified and paid for under the masonry classification of these specifications. Dry packing shall consist of hard, durable stone, approved by the said Chief Engineer, broken to the required size to pack well, and shall be well rammed in.

Work Required Before Acceptance.—Before tunnels are accepted, their whole length must be entirely cleared of debris, rubbish and surplus materials of every kind, and the bottom dressed off truly to the grade line, and the central drain cleaned out and filled with broken stone, as directed by the said Chief Engineer.

Night Work, if Required.—All work incident to the construction of tunnels shall be carried on by two (2) shifts of ten (10) hours each, or three (3) shifts of eight (8) hours each, as the said Chief Engineer shall direct.

TIMBER.

All timber must be sound, straight-grained and free from sap, loose or rotten knots, wind shakes, or any other defect that would impair its strength or durability. It must be sawed or hewed perfectly straight and to exact dimensions, with full corners and square edges. All framing must be done in a thoroughly workmanlike manner, and both material and workmanship shall be subject to the inspection of the said Chief Engineer, who may reject all timber not in accordance with the specifications.

IRON WORK.

Wrought Iron.—Wrought iron must be of the best quality of American refined iron, tough, ductile and capable of standing a tensile strain of fifty thousand (50,000) lbs. per sq. in. before rupture, and twenty-five thousand (25,000) lbs. without exceeding the limit of elasticity.

Cast Iron.—All castings must be made from good, tough pig metal, of a quality capable of bearing a weight of five hundred and fifty (550) lbs. suspended in the center of a bar one (1) in. square, four and one-half (4½) ft. between supports. All manufacture must be of first-class, well-finished character. Castings must be full to dimensions, true, smooth and sound.

Test bars of both wrought and cast iron shall be furnished by the said Contractor without cost when required by the said Chief Engineer.

GENERAL DIRECTIONS.

Duties of Contractors.—Contractors must satisfy themselves, by careful, personal examination of the nature and location of the work they bid for, of the general form of the surface of the ground, and all other matters which can in any way influence their contracts; and no information upon any such matters derived from the maps, plans, profiles, drawings or specifications, or from the Chief Engineer or his assistants, shall in any way relieve the Contractor from any risk, or from fulfilling any of the terms of this agreement.

Property on Right of Way.—Fences, buildings, timber and wood on the right of way along the line of the road, are the property of either the land owner or the Construction Company, and, if not removed by the land owner within a reasonable time, shall be declared off by the Contractor, piled up and preserved for the use of the Construction Company, without charge.

Damage to one Contractor through Fault of Another.—In case one portion of the work contracted to be done in accordance with these specifications is delayed through the negligence or incompetence of a contractor for some other portion of the work, whatever damage may result to, or whatever expense may be incurred by, the contractor so delayed, because of such negligence or incompetence, shall be charged to the contractor at fault, and the Chief Engineer shall decide the amount of damage or expense so to be charged.

Roads to be Opened.—Contractors having work awarded to them shall, immediately after signing their contracts, proceed to open and maintain such good and safe roads and paths for foot or horse travel along the whole line of their sections as may be directed by the Chief Engineer, and on portions of the line where there are no highways convenient for the wagoning of supplies, they must open and maintain such roads, and the Chief Engineer shall decide what extra amount, if any, they will be entitled to for this work.

Any persons having permission from the Chief Engineer shall be allowed to pass along or haul any materials required for the road over any section, such persons not interfering with or impeding the work of the Contractor.

Marks and Stakes to be Preserved.—Contractors must carefully preserve bench marks and stakes, and in case of willful or careless neglect, they shall be charged whatever the Chief Engineer shall consider an equitable amount to cover any damages arising from such negligence.

All excavations and embankments shall conform to the line and stakes set out by the Chief Engineer, and any excess of excavation or waste of material required for embankment at the mouths of cuts, due to neglect of these lines and stakes, shall not be estimated or paid for.

Grade.—The word "grade," whenever herein used, refers to the surface of the road-bed as completed and prepared for the reception of the ballast.

The specifications are hereby acknowledged, accepted and made part of this agreement.

Contractor.

President of the American Construction Company.

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BOND.

Know all men by these presents, that we are held and firmly bound unto the American Construction Company, in the sum of

Thousand Dollars, to be paid to the said American Construction Company, its successors and assigns, for which payment well and truly to be made we bind ourselves, our heirs, executors and administrators, jointly and severally, firmly by these presents. Sealed with our seals and dated this day of A. D. 188

Whereas,

ha entered into an agreement with the American Construction Company for the execution of the grading on Section No.

of the Division of the

South Pennsylvania Railroad, bearing date the day of A. D. 188

Now, the condition of this obligation is such that if the said

shall well and truly keep and perform all the terms and conditions of the said agreement on part to be kept and performed, and shall indemnify and save harmless the said American Construction Company as therein stipulated, then this obligation shall be of no effect, but otherwise it shall remain in full force and effect.

WITNESSES :

_____ _____ [L. S.]

_____ _____ [L. S.]

_____ _____ [L. S.]

State of }
of } *ss.:*
County of }

On this day of 188 , before me personally appeared to me known to be the person described in and who executed the foregoing bond, and acknowledged that executed the same.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 388.)

DLV.—WICHITA, KAN.

Wichita, Kansas, in lat. 37° 50' N. long., 98° W., is at the confluence of the Little and Big Arkansas Rivers, on level ground. It was settled in 1872.

Water-works were built by a private company in 1882, after plans of J. A. Jones, taking the supply from a well sunk 30 ft. below the water-line in gravel.

The water is pumped by two steam pumps, built by Smith, Vaile & Co., each of 1,750,000 gallons daily capacity, into a plate iron stand pipe 2½ ft. in diameter and 150 ft. high.

Distribution is by 10 miles of Wyckoff wooden pipe of 14 to 6 in. diameter, with 60 fire hydrants, 40 gates and 375 taps. Three meters are in use. Service pipes are of galvanized iron. The town pays $4,000 per annum for public water and hydrants.

The population in 1880 was 4,911. The daily consumption is not given.

The capital stock of the company is $100,000. The works cost $80,000. The bonded debt is $60,000. The receipts so far have been $10,000.

Samuel Houck is President and F. Williams Secretary of the company.

EARLY COMPLETION OF THE CORNWALL AND SAULT STE. MARIE ROAD.

The building of the Ontario Pacific Railway from Cornwall to Sault Ste. Marie is now an absolute certainty, notwithstanding the tremendous opposition the promoters had met with from interested parties. Mr. L. M. Shute, the Philadelphia capitalist and contractor, by herculean exertions and untiring zeal, has secured the capital necessary to proceed with the work by the sale of fourteen millions of dollars of first-mortgage bonds on the road. The contract and all agreements and documents entered into with Mr. L. M. Shute and his American capitalists have been ratified in Philadelphia, and handed over to the representative there, Mr. Bergin, the president of the road. The work will be commenced at once, and vigorously carried forward until winter sets in. Should the company not be able to get an entrance to Montreal from Smith's Falls by one or other of the existing railways, they will extend their line from that point, there being a charter available for the purpose. The promoters deny emphatically being in opposition to any of the great Canada lines, as they say they have an extensive field to work that does not interfere with the Canadian Pacific or Grand Trunk; in fact, they say the new road will be a feeder to the lines mentioned. The friends of the enterprise are jubilant this evening at their success. They claim to have met a friend in Mr. Senecal, who will also lend a helping hand to the project. The company has now prospects of getting liberal subsidies in land and money, which were not expected at first, and the only trouble of disposing of the bonds in America was the absence of bonus and securities; that was got over, however, and there is no longer any trouble looming ahead so far as finances are concerned.—*Toronto Globe, 18th.*

END OF TRACK, C. P. RAILROAD, }
NORTHWEST TER., July 8, 1883. }

RAPID TRACKLAYING ON THE C. P. R. R.—MY DEAR HAVEN: Inclosed please find copy of a report made by our engineer. As this excels any previous record of railroad building, it will doubtless be of interest to the many friends of our fellow-townsman, Mr. Donald Grant, to whose great administrative abilities and energy this result is due.

The health of our men is excellent, considering the warm and dry weather; yet we are very busy in looking after the few who are sick, as they are scattered over about 280 miles, 180 of which we travel over on buckboards. Our assistants from Fairbault, Dr. Ed. Wood, Ray Stauffacher and John Gwathmey are well and are doing splendidly in their separate duties.

Very truly, your friend,
F. M. ROSE, M. D.

C. P. R. R.—Construction West.

During the past week 24 miles and 1,090 yards of track have been added to the main line west, of the Canadian Pacific railroad. On Tuesday, July 3, 4 miles and 1,180 yards were laid, and on Saturday, July 7, 6 miles and 40 yards. On neither day was an extra preparation made, and the same force was at work that is daily employed; merely a greater effort was made, and the time a little prolonged. The latter great record was made in fourteen working hours, and the first three miles were completed in six and one-half hours. To show that it was an extraordinary feat, a statement of the tracklaying, men employed, etc., will explain.

Twenty-four men handled the iron, twelve unloading off cars and reloading on trolleys, and the same number laid it down on the track. Three iron cars, or trolleys, were used, and as fast as one was unloaded it was run back till met by a loaded car, when it was tilted off the track and the loaded truck run by, as is usual every day. The twelve rear iron car men loaded 2,120 rails (604 tons) during the day, and the five men on each side of the front car laid down 1,060 rails (302 tons) each gang, and the two distributors of angle plates and bolts, and adjusters of the rails for running out over the rollers, handled 2,120 rails, 4,224 plates and 8,848 bolts; fifteen bolters followed and averaged 565 bolts each; then thirty-two spikers, with a nipper to each pair, who drove 63,600 spikes, which were distributed by four peddlers; the lead and gauge spikers each drove 2,120 spikes, averaging 8,000 blows to drive them, or 570 in the hour. Sixteen thousand ties were unloaded off trains and reloaded on wagons by thirty-two men, and thirty-three teams hauled them on the track; averaging seventeen loads, of thirty ties to the team; there eight men unloaded and distributed, and four spaced them; two also spaced and distanced the joint ties, and two arranged joint and displaced ties immediately ahead of the spikers. Four iron car boys and six horses were used to haul the iron out. The first two miles of material was hauled ten miles, and the rest from three miles up, as the usual side track gang put in a siding of 2,000 feet in the day. Thirty-six cars of rails came up in six trains, and sixty cars of ties. It should be mentioned that the track was over a light, ascending grade across an undulating prairie, and five curves came in on the distance, necessitating the cutting of fifteen rails, causing thereby considerable delay.

The credit for executing this wonderful performance and managing the organization of men to do it easily and without a single hitch, is due to Mr. Donald Grant, the manager of the track-laying department of the firm of L. S. & Co., who superintended the work in person; to Mr. J. H. Benson, the track-laying foreman, who attended to it with his usual energy and adroitness, even cutting most of the rails for the curves himself, and to Mr. Thomas Gannon, the iron car foreman, whose untiring strength, ceaseless activity and perfect work was a grand example for the rest to follow. They were dependent on their men, who throughout worked with a vim, power and manner that only thorough workmen and earnest, dutiful toilers can effect. Credit is alse due to Messrs. C. Shields, E. A. Franklin and W. Lawton, of the Canadian Pacific Railroad, for their indefatigable and successful efforts to get the material to the front.

Messrs. Langdon, Shepard & Co. should be congratulated for their wonderful work on this road, as that of last year and this places them ahead as the foremost railroad contractors of the world.

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NOTICES OF MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.

The Autumn meeting of the Institute will be held in Troy, N. Y., during the second week in October. This meeting will be mainly devoted to the reading and discussion of papers.

Members who wish their papers fully discussed at the meeting can have them printed and circulated in advance, if they are sent to the Secretary early in September.

THOMAS M. DROWN, Secretary.
R. W. HUNT, President, Troy, N. Y.

ENGINEERING SOCIETIES.—The Colorado Institute of Engineers, with headquarters at Leadville, Col., has dissolved its organization.

The Engineers' Club of Kansas City has been organized with 19 members, and a printed constitution and by-laws. It has been incoporated by the State Legislature of Missouri. Robert Gillham is Secretary.

The Engineers' Society of Western Pennsylvania, is located at Pittsburgh, Pa., and has a large and influential membership. Jas. H. Harlow, Secretary.

HYDRAULIC TABLES.

"Hydraulic Tables for the Calculation of the Discharge through Sewers, Pipes and Conduits, based on Kutter's Formula," by P. J. Flynn, C. E.: No, 67 Van Nostrand Science Series.

This little book is eminently of the labor-saving kind; the formula of Kutter is complicated in form and tedious of solution, and in presenting this data in a tabular form the author certainly deserves the thanks of the profession of engineers.

The tables are calculated with the coefficient *N* adapted to "foul or slightly tuberculated pipes; cement and terra-cotta pipes, with imperfect joints and in bad order; well-dressed stone-work and second class brick-work;" in fact, the conditions usually found in practice; they do not apply to smooth or plastered surfaces.

Table I. is devoted to circular sewers and conduits running full, giving the values of the area of cross-section of water, and the hydraulic mean depth, and the factors to be used with the coefficient *N* for the conditions given above.

Table II. gives the values of the sine of slope and its square work.

The latter part of the book is devoted to the consideration of egg-shaped sewers, with hydraulic tables based on Kutter's formula. Price, 50 cts.

THE SPECIFICATIONS OF THE AMERICAN CONSTRUCTION CO.

Our readers will note several new departures in the writing of specifications in the copy printed in this issue. The bids are to be very detailed, almost every possible condition and kind of work being fully specified, and under each head the class of work so covered by the contract price is as clearly expressed as possible, leaving little room for doubt or dispute. "Excavation in water," is a recent classification, and a proper one.

In requiring the embankments behind bridge abutments to be carefully rammed, the end in view is economy in masonry. The modern practice, especially as followed upon the Penna. R. R., results in walls that in the lack of thickness would have astonished the generation of engineers just passed away; but the present methods are the results of experience and observation. In replacing old masonry with a better class of work on the line of the Penna. R. R. it had been found that with a bank solidified by years of use with *all* settlement at an end, a facing wall was practically all that was needed. Reasoning from this, abutment filling is now rammed, rolled and often watered, to reduce the settlement to a minimum, and at the same time reduce the horizontal thrust against the wall; the result is less masonry.

"Over-haul" is another fruitful source of difference between the contractor and the engineer; in this case, the distance to be hauled is fixed at 1,000 ft., not 1,400, as some engineers demand, and a price fixed per cubic yard per 100 ft. hauled beyond the prescribed distance; the contractor can figure accordingly upon his excavation price. Ballast must be broken to pass through a 2½-inch ring "in any direction." This is sufficient and usual, though we know of engineers who require a 2-inch ring to be used, resulting in waste of material and labor without a compensating result in the road-bed.

"Masonry" is described under twenty-two headings, and as a special head we have "What the price named is to cover." The composition of cement and lime, mortar and concrete is fully expressed.

Tunnel work is to be paid for by the cubic yard or lineal foot, in case the latter bid is accepted. The price is to cover all material contained between the two portals. In this these specifications stick to old-time usages. Some engineers now require a classification of tunnel excavations into rock, loose rock, earth, etc. The latter practice is all very well, if the classification is exact and just; but just there is the trouble. In no case is more judgment and experience demanded on the part of the engineer.

The specification for iron work is too meager, if bridge work is included under this head; but we imagine, from the attention to detail shown in other portions of the specifications, that a separate and distinct form is prepared for this class of work.

Charging the contractor the cost of replacing stakes, bench marks, etc., will be the occasion of some energetic remarks on the part of those old-timers, who seemed in our railroad days to take especial pains to run down our stakes, and preserved our "plugs" by carrying them up to the shanty.

These specifications, as exemplifying model modern practice, will well repay study.

FOREIGN ENGINEERING ENTERPRISES.

There are several large engineering projects at present on the *tapis* in Europe. There is plenty of capital, and the bridge between contemplation and realization may be passed over or not according to the energy of speculators and the trust of investors. From our foreign exchanges we find the following large projects discussed:

"A new examination committee has been formed for cutting a canal between the Ocean and the Mediterranean."

This project has come up at various times, and would practically do away with the long, and, according to the song, "rough passage" through the Bay of Biscay, would deprive Gibraltar of its importance, and would open up a new route for the Mediterranean. The great objection to this canal, which would run from near Bordeaux to Narbonne, would be, if we remember rightly, the large number of locks required.

Among the committee at the head of this plan are Messrs. Constans Hersent (of the Panama Canal), and several of the most prominent French contractors and engineers. Three hundred thousand francs have been already subscribed toward defraying the expenses of the preliminary survey.

M. de Granvoix, civil engineer, has got out his surveys for a canal between Liege and Hasselt. Supplementary surveys have been made for a junction between the Meuse and the Scheldt. The new canal would be 32 kilometres from Liege to Tongres, and 57 kilometres from Liege to Hasselt, reducing the distance by 58 per cent. The cost is placed at from 12 to 13 million francs.

The plans for forming a connection between the Scheldt and the Meuse are no fewer than three: 1st, via Hasselt, Quadmechelen and Herenthals; 2d, via Hassel, Bolderberg, Diest and the Ruppel Canal; 3d, along the valleys of the Faer, Herck and Demer. The second scheme is the one, however, favored by the author.

There still remains immense canal work to be done in Europe. The glorious Rhine has actually no sea outlet, and good as the Dutch are at "dams" they have never been able to regulate the Waal, or known what became of the Rhine. The Elbe Canal will also be a great work although it may be retarded by political complications in Prussia. A Committee of Engineers has been appointed for reporting on the removal of the obstructions of the Iron gate on the Danube. In fact there is no absolute impediment to Vienna becoming one day a great port.

In England nothing is doing in the way of canal cutting, although the Manchester canal project crops up periodically. While practically possible, it may be doubted whether the extra expense involved in transhipping cotton (and this would be the only freight almost) from Liverpool to Manchester would not be counterbalanced by the lesser tonnage of vessels and by the disturbance of existing commercial relations. It is not the river, but the tide that saves Liverpool, and the Mersey beyond Runcorn does not amount to much.

Although a great deal of discussion has been indulged in as to whether canals can profitably compete with railroads, it would seem that the English canals are fairly profitable, but this is owing to the nature of their freight—coal, stones, etc. When merchandise of a perishable nature has to be shipped the preference is always given to the iron horse.

The new Northern Canal in France will be 235 kilometres in length, 49 of which will be taken from already existing water-ways. It starts from Courcelles-les-Lens, in the vicinity of Donai, and will end at the light sluice between St. Denis and Paris. The coal trade will largely benefit by it.

A NEW METER (ITE).

This is just the season of the year for them. A few days late, perhaps, for the "grand display," yet in time to make a good deal of show. It came to earth in East Boston, where, after a careful analysis by several enthusiastic gentlemen who discovered it, it was further investigated by the recently appointed superintendent of meters—late of the Mystic department—who after "testing" it for "14 consecutive days or 336 hours" with water and sundry substances which the Boston people "take with theirs," "such as sand, straw, gravel, shells, eelgrass, shreds of cotton waste, wads of oakum, dried leaves and moss," it was declared of all meters to be "the best constructed in material, mechanical skill and device, and all that goes to make a good instrument;" and the superintendent has "no hesitation in recommending it to the board as the most reliable and best meter in all respects to adopt for general use." It is called the "Tremont."

The other meters in competiton were the Worthington, Ball and Fitts, Equitable, Crown, Standard, Balance Valve and Undine; there were also the Boston, Continental, and Diaphragm or Spooner, but these gave out before the test came to a close, and so were not officially reported. During the past year a most elaborate series of tests of all the water meters obtainable have been in progress under the supervision of Superintendent Jones, of the Water Department. Exit Jones from the Meter Department, and all others who have had anything to do with the previous testing, and after "14 consecutive days" of trial, the old-established meters—the only ones that have maintained their place in the market against all newcomers—are declared inferior to a meter which, until the publication of the article announcing its adoption, in the Boston *Herald* of the 18th, was unknown among water-works officials or meter manufacturers. We will wager the price of one of the new meters that, up to the publication of that article, the existence of the Tremont meter was not even suspected among the higher officials of the Water Department of Boston, excepting, of course, the Commissioners. The officers of the Tremont Co. are Mr. Frederick Curtis, President; Mr. Francis A. Raymond, Treasurer; Hon. Moody Merrill is a director; 3,000 to 4,000 meters are to be put in as fast as possible; they will be manufactured by the American Arms

Co., at East Boston, of which company Mr. Francis A. Raymond is a director; the price is not stated, but it is expected that about $100,000 will be expended this year by the city of Boston. It is expected that by the close of the year sufficient evidence of the value of these meters will be obtained to warrant an appropriation for further extension of the service.

Several water meter "stock companies" have originated in Boston. We have unpaid advertising bills against two of them, which in their day made quite a splurge, and most likely unloaded some of their lithographs on their confiding friends. Meter stock depends on water for its value; if any of the new company's is in the market, it will be safe for sanguine investors to await the test of a few months of the new "instrument" in digesting the fearful mixture which the report of Supt. Cutts plainly intimates is delivered to consumers of water in Boston.

New York City has been "struck" by water meters within the memory of the present generation. Once it had a regular shower of them, and about 10,000 of the best specimens were collected, and they are still on hand in one of the city government junk warehouses, while the suit over the bill for them is still pending. The literature of the Navarro meter, as published in the New York dailies of Feb. 1 to 10, 1872, is still interesting reading. After "carefully conducted" tests of about forty different meters, extending over three months of time, a meter, till then unheard-of, was brought out and adopted. The overthrow of Tweed saved the city from the deluge which was threatened. The "despised and rejected" meters are now, and have been for years, in constant and increasing use by the Croton department, while the piles of the "very best meter," according to the Navarro circular of 1872, now before us, furnishes a warning monument to New York officials against this class of disturbances that occasionally "strike" only large and loosely governed cities.

Perhaps the Tremont meter may be the *Tombstone* of the Boston Board.

THE NEXT PHASE OF THE LABOR QUESTION.

The failure of the telegraphers' strike would seem to indicate that the strongest possible combinations of labor under intelligent leadership are unable to benefit their members; unable to win better wages by the striking process. A few years ago the general strike among the railway engineers terminated as has the strike of the telegraphers. The freight handlers' strike last year was a failure also. For years past the strikes of the miners have been little less than failures. Looking over the history of industrial agitations for the past ten years, we find that heavy combinations among workingmen to secure higher wages have almost universally failed, while local strikes, limited to a few hundred men, have frequently succeeded. This has been shown in a great many cases; for instance, during the past nineteen years there have been 362 strikes among the cigarmakers. Of these 213 were gained, 137 lost, and 12 compromised. Notwithstanding the assertions to the contrary, strikes have resulted in good of a twofold character. First, wages have been advanced; and second, the aggregate gain has largely overbalanced the losses during the time of striking. This fact is frequently controverted, and it has been shown by industrious writers how many months and years it would take for strikers to make up for the losses sustained. In numerous individual cases, the statement is true. But, taking it as a whole, it must be admitted that the system of striking has advanced compensation to a greater degree, and the total advantage has been greater than it could possibly have been but for the agency of strikes. Were it not so wage-workers would not be so persevering in their struggles. These admissions of facts, not sufficiently well known, are by no means intended as an indorsement of strikes. On the contrary, a careful study of strikes and their results should lead employers, manufacturers and the directors of our great corporations to a most serious consideration of some practical method whereby strikes could be avoided, and some system established which would secure, if nothing else, an enforced harmony between capital and labor. The fact cannot be lost sight of, that labor is gaining year by year, in its power to enforce its desires or decrees, and that it is only a question of time, when what are now defeats, will be transformed into victories. Defeats are simply disciplinary influences which will point out to blind labor the way to go next time. The telegraphers made two or three serious mistakes, the greatest of which was striking at all. Had they struck for a reduction in the hours of labor, public opinion would have indorsed them, and in all probability their request would have been granted, had it been presented in a respectful and business-like manner; but, made as it was, under threats, and without any regard to the interests of their employers, it was but right that the entire power of the corporation affected should be brought to bear against this attack upon them, and upon their corporate rights. The telegraphers made a serious mistake in pooling their issues, and striking for everything at once. Such a great corporation as the Western Union could not, consistently to its own interests, pursue any other course than it did. Employers everywhere have common interests, to a certain extent. The Western Union, in fighting its own battle fought the battle of all other employers. But the result is not now foreseen. Instead of discouraging labor, it will have the very opposite effect, and unite it, not for any immediate and aggressive action, nor for action in the same manner as has been pursued, but in an entirely different way. "Labor Reformers," as they are called, who understand the labor question in all its bearings, have been for years counseling a modification of tactics, and have been urging that the question of hours of labor be made the only one, and that all other questions and matters of wages be left to take care of themselves until the great fundamental question of fewer hours per day be decided. The battle has been carried on for fifteen years, to use a labor reform phrase, in government workshops, where it is desired that the system be first established. But the government officials, knowing what is to be gained by holding to the present system, and what is to be lost by departing from it, stubbornly refuse to give practical enforcement to the eight-hour law passed by Congress in 1868, and they have virtually disobeyed its provisions ever since. The next great labor struggle will be for fewer hours. What its outcome will be, it is of course impossible to say. Whether it would make the condition of the laborer practically better is a matter which the experiment only can determine. As long as there is such an enormous supply of foreign labor the operation of economic laws will tend to maintain a sort of equilibrium between home and foreign conditions and wages. In New York City but few non-union men can be found inside or outside of the building trades. The same is true of other large cities. Trades-unionism is growing, and yet it is declared that it is a foreign product and not indigenous to this country. Nevertheless, American laborers are flocking into trades-unionism; if the foreigners introduced it, Americans accept it and become its champions. The hostility with which it is considered by employers shows that it is a power whose overthrow is earnestly desired. The workmen are not to be blamed for being trades-unionists, from the standpoint of selfish interest, any more than employers are to be blamed for forming leagues for their protection, or for railroad companies to form pools or capitalists syndicates. It seems to be the tendency of the time.

The practical question with which practical men have to do is not how the liberty of laborers can be restricted by legislation or combination of any kind, but how the interests of both the great factors of production, viz., capital and labor, can be brought into harmonious relations. That this is possible admits of no well-founded doubt. No efforts commensurate with the magnitude of the interests at stake have ever been made. The government might, and from all indications in sight could, take some measures for the establishment of a bureau whose functions should be to aid in bringing about the result desired. Perhaps the government could do but little, but it should do what it could in providing for the gathering of such information as might be necessary for the enactment of laws for the establishment of regulations which would act as lightning rods to avert the danger of strikes, and would also make the workingmen feel that their government had at least some perfunctory interest in their welfare. Great Britain has rigid laws, which are honestly enforced; France has the *Conseils de Proudhommes;* their merchants and manufacturers have trade tribunals. So far we have permitted things to go at loose ends, and are now suffering some of the consequences. It is extremely unwise for the employing interests of this country to allow the striking spirit to make such headway as it is making, and to allow labor organizations such a wide field for the building up of great combinations of labor.

MILWAUKEE PUBLIC WORKS.

We are indebted to G. H. Benzenberg, City Engineer, for a copy of the report of the Milwaukee Board of Public Works for 1882. From it we make the following abstracts:

The total income from the water-works was $200,749.10; $124,475.41 of this amount was from regular water rates, and $44,386,51 from metered water. The total gallons consumed, that is pumped, in 1882, was 5,362,000,765, giving an equivalent revenue of $37.44 per million gallons. The increase in water rates was $20,242.24 in excess of the receipts for 1881.

The annual waste of water is enormous; on some days, when the temperature was quite low, the consumption increased at once three to four million gallons per day. During cold nights, the consumption from 10 P. M. to 6 A. M. has been found greater than for any other eight hours in the day. The use of meters has demonstrated this waste; a table is given showing the water used in a few instances the first month after the meter was connected, and to what, by economical use, the consumers have reduced the present average consumption:

Consumption the first month.	Present average consumption.	Difference.
89,775 Gallons.	60,900 Gallons.	28,875 Gallons.
190,500 "	24,000 "	166,500 "
123,600 "	39,750 "	83,850 "
161,375 "	57,750 "	103,625 "
435,140 "	300,000 "	135,140 "
147,000 "	18,000 "	129,000 "
203,800 "	5,800 "	198,000 "

This is a startling exhibit, and while the cause of these discrepancies is not specifically stated in the report, it is suggestive of thought on the part of cities called upon to increase their water supply.

In Milwaukee there are now 106 indicators and 91 meters in use; over 22 per cent. of the collected water rates was so measured, though only ten per cent. of the total consumption is so controlled.

The Chief Engineer thinks that the only effectual method of stopping waste is by the use of meters, especially in business and manufacturing places, where he finds the wastage the greatest. The consumer, in other words, must be *forced* to practice economy, or pay for his negligence.

During the year 1882 9,303 lin. ft. of brick sewer, and 25,513 lin. ft. of pipe sewer were laid, a total of $6\frac{513}{1000}$ miles at a total cost of $81,916.16. The total lengths of sewer now laid in the city is $106\frac{513}{1000}$ miles, costing $1,227,248.87. The special sewer under the Milwaukee River was contracted for in Dec. 1881. There were to be two shafts, one on each side of the river; trouble was experienced in the shafts from sand and water, and in June last the contractor abandoned the work. A dock must be built fronting this work before it

can be continued, as the surface of the ground has sunk for some distance around the shaft, below the surface of the river.

Section 3 of the special sewer, consisting of a gate and a siphon shaft, and a sewer 5 ft. 4 in. in diameter, 342 ft. long, was completed Sept. 20, 1882, at a cost of $8,630. This is the only section of the special sewer entirely completed.

The total length of streets and alleys improved by grading, graveling and paving during 1882, is $11\frac{1356}{1000}$ miles; in the execution of this work, the following were the amounts and costs:

153,593 cubic yards of excavation, cost..... } 72,119 cubic yards of filling, cost ..... }	$44,057.39
26,302¼ cubic yards of gravel, cost	21,432.77
51,015⅛ square yards of cedar block paving, cost.....	60,007.38
23,245 square yards of gutter paving, cost.....	10,103.14
23,033 square yards of alley paving, cost.....	10,299.24
13,216 lineal feet of stone curbing, cost	8,546.59
4,314 lineal feet of wood curbing, cost.....	883.12
34,067 4-10 lineal feet of sidewalk, cost	9,084.76
4,550 square yards of granite paving, cost.....	11,375.00
Total.....	$175,789.39

The wood pavement is in a generally decayed condition, and needs relaying; the Board condemn this class of pavement, and recommend that it be abandoned at once, and propose stone blocks for the business streets, and carefully prepared broken stone pavement for the other streets. Health and convenience both demand well-paved and well-kept streets.

Street sprinkling was done by men and teams employed by the day, the city furnishing sprinkling apparatus, and cost $28,782.78.

THE STATUE OF LIBERTY.

The Aug. 1st number of *Le Génie Civil* contains an exceedingly interesting illustrated paper on the Bartholdi Statue of Liberty, by Ch. Talansier, C. E. The matter, with its accompanying sketches, strain diagrams, &c., is too voluminous for reproduction, in this journal, and we must refer those interested to the original.

The entire statue will be completed in a few weeks. Mr. Eiffel the engineer of the famous Douro Bridge, and at present in charge of the Garabit Viaduct—to be the highest bridge in the world—was the designer of the iron framework which is ultimately to support the exterior of beaten copper plates which form the figure. The copper work was done in the shops of the Messrs. Gaget, Gauthier & Co., in Paris.

It is not generally known that as long ago as 1697 a colossal statue of St. Charles Borromeo was erected near Arona, on the borders of Lake Majeur, which in its construction approaches very nearly that of Bartholdi. The height of this Saint is $77\frac{3}{10}$ ft., with the pedestal it is 116 ft. high; it was the work of the sculptor Cerani. It is likewise formed of beaten copper plates on an iron framework, but contains inside a mass of masonry reaching to the neck.

We quote the following dimensions as giving some idea of the huge proportions of the statue of Liberty. From the base of the figure to the summit of the torch 150 ft. 10 in, the index finger is 8 ft. long and 4 ft. 9 in. in circumference at the second joint, the finger nail is 10×13 in.; the head is 14 ft. $5\frac{1}{4}$ in. high. Recently a dinner of 26 covers was served in a mid section of the body, and there was plenty of room to spare. The total weight of the statue is 440,000 pounds, of which 176,000 pounds are copper, the remainder wrought iron.

In sending the statue to the United States, it will be dismembered in more than 300 pieces, to be riveted together again piece by piece upon its foundation.

To prevent any accident from the unequal expansions of the two metals, copper and iron, the iron frame is not riveted to the copper shell, but each abutting piece simply slides in a copper grooved plate fastened to the shell.

Galvanic action between the copper and iron, exposed as this statue will be to currents of air charged with salt, etc., will be guarded against when the figure is finally erected in New York, by inserting small copper plates, coated with red lead, between the sheets of copper and the iron framing wherever they meet. This method has been successfully used in the sheathing of ships.

The ultimate cost is difficult to fix with any precision. *Le Génie Civil* says the metal portion will cost about $80,000, or by the time the statue reaches New York about $120,000, and with the pedestal, to be erected by the Americans, puts the total cost at $240,000.

The remainder portion of the paper is devoted to the strain diagrams and calculations, which seem to have been most conscientiously worked out in all detail.

THE WASTE OF WATER.

The *prevention of the waste* of water already dealt out to the consumers by existing works is a more important subject for investigation than the extension of facilities for still further waste.

According to the last report of the city of Milwaukee, an abstract of which is published in this issue, it frequently happens that between the hours of 10 p. m. and 6 a. m., when all honest water consumers should be in bed, more water is drawn from the city mains than in any eight hours of daylight. The excess quantity is given as four millions of gallons; this, divided among a population of 115,000, is about 35 gallons per head *wasted*—an amount sufficient for the daily legitimate use of the citizens, and more than is dealt out per day in many English and continental cities.

In the same report is a startling tabular statement of the quantity of water consumed before and after the introduction of meters. Just why a party should use 203,800 gallons per month when he did not directly pay for it, and should suddenly discover that 5,800 gallons for the same period was sufficient for his needs, as soon as the water was to be paid for *by measure*, is a knotty question to solve. In any other transaction, we should call this abuse of privilege dishonest; he is either robbing his neighbor of water or of money to pay for more water.

"But water costs nothing" is the common opinion and answer of the ignorant and wasteful consumer. It *does cost* fuel and attendance and interest on the general plant, as any one will find out who studies the annual appropriations of his city. In Milwaukee, for instance, the entire system has cost to date $2,374,274; and New York, with 90,000,000 gallons per day on hand to be divided among one and a quarter million of people, has almost under way a scheme for a further extension of supply, to cost probably twenty millions of dollars.

How to prevent this known waste of water and of cash is a question more easily discussed than answered. The Milwaukee authorities say, force economy by measuring out the daily supply, and if a man will persist in waste, let him pay for his negligence. The present meter system seems to us certainly the best adapted to meet the difficulty in the case of mills and large factories where the greatest individual misuse of water is located. But what are we to do with our dwellings? Even though the waste may be small in each, the aggregate swells to an enormous total!

The vents for water in the distributing system of a large city are almost countless, and to protect them all against abuse is an exceedingly difficult contract. A very respectable percentage of water pumped in most cities finds its way into the ground or adjacent sewers, through leaking joints in the mains. The waterphone of recent introduction has been the means of discovering and having repaired some alarming waste from this cause; and it has also been utilized in checking abuse among consumers.

The average user of water cannot be reasoned with; he must be forced to a proper economy; and he who will suggest the best means, and the best method of putting into practice his suggestions, will be deserving of the unbounded thanks of all taxpayers, and he will put money in his purse as well.

The intermittent or tank-system of England will not answer; it has many objectionable features, and among the most serious is the fact that users will not properly clean them, and hence the tanks become breeders of disease, instead of dispensers of nature's most precious fluid.

We measure out gas in every house, and though the supply becomes more complicated in the case of water, we must ultimately resort to universal metering. With present experience, we see no other way of putting a stop to the waste of public money now going on in all our larger cities, in providing further food for waste; the evil grows in proportion to the supply.

There is a certain sentimental dislike to the limitation of an individual water supply that is as groundless in fact as it is expensive in application; it must be resolutely cast aside. When sifted the problem is one in which all have a vital interest, though few seem to realize it.

THE DEPTH AND VELOCITY OF NIAGARA RIVER.

NIAGARA FALLS, Aug. 8th, 1883.

EDITOR ENGINEERING NEWS:

Since the attempt of Capt. Webb to swim the Whirlpool Rapids, there has been a great deal of discussion in regard to the depth and velocity of the water at that point. The editor of the *Gazette* has obtained the opinion of a large number of persons supposed to be well acquainted with the locality. These opinions vary; in depth, from 16 ft. to 350 ft., and in velocity from 15 miles an hour to 40 miles. My own estimate was, depth 46 ft., velocity 15 miles an hour. I send the following data for the Rapids, and also elevations and fall of the river from Lake Erie to Lake Ontario. I have obtained these data by running a line of levels from the bench marks of 1876 of the Erie Canal, and from the report of the Lake Survey, by Gen. C. B. Comstock, 1875: Elevation of Lake Erie, 572.96 ft. above tide-water; elevation Lake Ontario, 246.61 ft. above tide-water, making a descent of 326.35 ft., distributed as follows: From Lake Erie to Port Day (one mile above American Falls), the fall is 11.5 ft., from Port Day to top of American Falls, 48.85 ft.; American Falls, 167 ft.; from bottom of falls to Lake Ontario, 99 ft. Total, 326.35 ft. From a point 850 ft. above the Old Suspension Bridge to a point 500 ft. below the outlet of whirlpool, a distance of 1¼ miles, the fall is 60 ft. The greatest fall in any 1,000 ft. is 20 ft.; from the above point (850 ft. above Old Bridge), for 3,500 ft. the fall is 40 ft. The width of the river above the entrance to Rapids, 1,000 ft.; through Rapids averages 400 ft. The discharge is, from Lake Survey, 275,000 cu. ft. per second; from report of State Geologist, from three observations made at Black Rock (near Lake Erie), 1838, during high water, none of which vared over 20,000 cu. ft. per minute, the discharge was 325,000 cu. ft. per second.

If the fall were 20 ft. at one fall and without resistance, the velocity would be 24.6 miles per hour; but, owing to friction, it is not over 0.8 as much, or 19.7 miles. Now this fall of 20 ft. being in a distance of 1,000 ft. the velocity is much less. I estimate it as not *greater* than 15 miles per hour, *and probably* it does not exceed 12 miles, except in a few places where the water is piled up in the center.

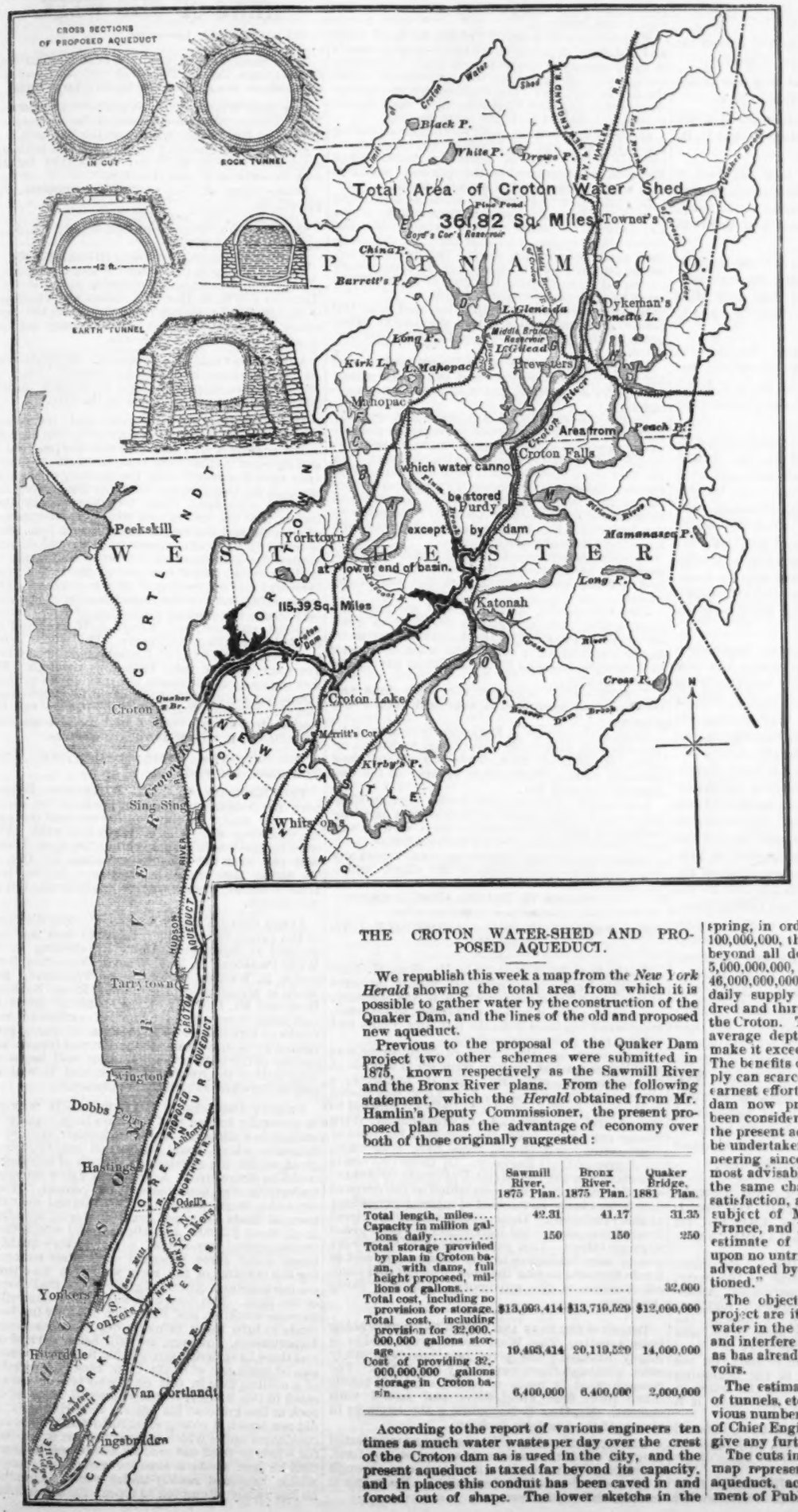
Capt. Webb was 4 minutes going from the bridge to where he was last seen, less than one mile. Above the falls from Goat Island Bridge to American Falls, 1,000 ft., the fall is 17 ft., and a measured velocity of 8.2 miles per hour.

When Capt. Joel Robinson took the Maid of the Mist through the Rapids in 1861, she made the trip to Queenstown, a distance of 5 miles, in 17 minutes. His son John Robinson informs me, that he fired her up himself, and that there was 90 lbs. of steam on her, her engines were going all the time, and she made no stop in the whirlpool.

If you think the above would be of interest to your readers, I would like to see the opinions of other engineers on the subject.

Yours respectfully,

DRAKE WHITNEY, C.E.



THE CROTON WATER-SHED AND PROPOSED AQUEDUCT.

We republish this week a map from the *New York Herald* showing the total area from which it is possible to gather water by the construction of the Quaker Dam, and the lines of the old and proposed new aqueduct.

Previous to the proposal of the Quaker Dam project two other schemes were submitted in 1875, known respectively as the Sawmill River and the Bronx River plans. From the following statement, which the *Herald* obtained from Mr. Hamlin's Deputy Commissioner, the present proposed plan has the advantage of economy over both of those originally suggested:

	Sawmill River, 1875 Plan.	Bronx River, 1875 Plan.	Quaker Bridge, 1881 Plan.
Total length, miles	42.31	41.17	31.35
Capacity in million gallons daily	150	150	250
Total storage provided by plan in Croton basin, with dams, full height proposed, millions of gallons	.....	.....	32,000
Total cost, including no provision for storage.	$13,093,414	$13,710,529	$12,000,000
Total cost, including provision for 32,000,000,000 gallons storage	19,493,414	20,119,529	14,000,000
Cost of providing 32,000,000,000 gallons storage in Croton basin	6,400,000	6,400,000	2,000,000

According to the report of various engineers ten times as much water wastes per day over the crest of the Croton dam as is used in the city, and the present aqueduct is taxed far beyond its capacity, and in places this conduit has been caved in and forced out of shape. The lower sketchs in the upper left hand corner of the map show, one a section of the present aqueduct, filled much above its proper capacity, the other cut represents a section of the present aqueduct at the Aspinwall Embankment as it appeared before repairs. In this case the water being carried too high has passed out the sides of the conduit.

Within its extreme limits the Croton water-shed contains 361 square miles, as indicated on the accompanying map. Inside the extreme limiting line is another which includes the area from which water cannot be stored except by the building of a dam at the lower end of the basin. The heavy black spaces from Quaker Bridge up to Plum Brook represent the area of the new reservoir, to be created by the building of the dam at Quaker Bridge, in which the surface of water will be thirty feet higher than in the present Croton Lake, and will contain, according to the engineers' estimate, a water supply of 100,000,000 gallons per day for 160 days, or in other words, after this reservoir is once filled, a five months' failure of the Croton River would not interfere with the water supply to the consumers of New York City.

In advocating the erection of the Quaker Dam, which will be the second largest in the world, if built, the engineers say they have found a good rock foundation for it, and present the following considerations in its behalf:

"The top water line for the reservoir to be formed by the dam was run at 200 ft. above mean tide, Croton grade. The present Croton Lake is $167\frac{17}{100}$ ft. above the same datum. Calculations based upon these surveys show that the reservoir would contain over 32,000,000,000 of United States gallons of storage above the level necessary to supply an aqueduct capable of conveying about 250,000,000 per day to the city; or with a delivery of 200,000,000 per day (twice our present supply), the aqueduct would be supplied for 160 days without a gallon from the natural flow of the Croton. The existing storage in reservoirs and lakes is 9,000,000,000. The reservoir, which will be begun in the spring, in order to place the full daily supply of 100,000,000, the full capacity of present aqueduct, beyond all doubt, and which is to contain about 5,000,000,000, would make the total storage nearly 46,000,000,000 of gallons—sufficient to keep up a daily supply of 200,000,000 for nearly two hundred and thirty days, without the natural flow of the Croton. The great area, 3,635 acres, and great average depth of this new Croton lake would make it exceedingly valuable as a settling basin. The benefits of such a condition of the water supply can scarcely be overestimated, and hence the earnest efforts to take advantage of them. The dam now proposed is a work that would have been considered, at the time of the construction of the present aqueduct, of too great magnitude to be undertaken. The remarkable progress of engineering since then makes such a structure the most advisable in this case. Successful works of the same character in France have given great satisfaction, and confirm fully the theories on this subject of Messrs. Montgolfier and Delocre, of France, and Professor Rankine, of England. The estimate of the cost of this dam has been based upon no untried principles, but upon those so ably advocated by the eminent engineers above mentioned."

The objections advanced to the Quaker Dam project are its great cost, and the area of shoal water in the reservoir, which will cause sickness and interfere with the quality of the stored water, as has already been the case in the Boston reservoirs.

The estimated cost, length of line, distribution of tunnels, etc., we have already given in a previous number of the NEWS. As soon as the report of Chief Engineer Newton is made public, we will give any further data of interest.

The cuts in the upper left-hand corner of the map represent various sections of the proposed aqueduct, according to the plans in the Department of Public Works.

PERSONAL.

J. C. MATHEWS and A. M. CRAFTS, surveyors, returned to Fort Collins (Col.) from Wyoming.

W. D. BARCLAY, C. E., is Chief Engineer of the Selkirk Branch of the Canadian Pacific R. R.

CHAS. A. HILL has been elected President of the Highland Junction and Storm King Bridge R. R. Co.

J. WILLIAM HARRIS, C. E., late Engineer in Charge of the quarries and masonry on the Atlantic and Pacific R. R. from Albuquerque to the front, 572 miles, has resigned his position and returned to Boston.

THE name of the Harrisburg & Western R. R. has been changed to that of South Pennsylvania R. R. Its offices are Room 26, 8th floor Mills Building, New York City. The Chief Engineer is OLIVER W. BARNES.

BENJAMIN S. CHURCH, Resident Engineer at Scarboro of the Department of Public Works, has been appointed Chief Engineer of the new Aqueduct Commission. The office of the Commission is No. 78 Tribune Building.

FREDERICK H. SMITH, Engineer and Geologist, formerly of the Baltimore Bridge Co., but obliged by failing health to abandon that business, has so far regained his good health that he has re-opened his office at 13 German St., Baltimore, and is open to engagements in the strict line of his profession. Mr. SMITH has already been retained to design and direct the construction of a large steamship pier and storehouses, and also to make several mineral and industrial surveys. Mr. SMITH is the author of a very popular little book on Rocks, Minerals and Stocks.

CAPTAIN CARLISLE P. PATTERSON, Superintendent of the Coast Survey, after whom the new steam coast survey propeller now being built has been named, died on the 6th of October, 1880, at Brentwood, his residence, near Washington. He was the son of Commodore D. S. PATTERSON, and was born at Shieldsborough Bay, St. Louis, La., Aug. 24, 1816. In 1838 he graduated from Georgetown College, Ky. In the same year he was assigned to the Coast Survey, where he served three years, after which he went to sea. He re-entered the Coast Survey service in 1845, and carried out some very important surveys in the Gulf of Mexico. In 1849 he accepted the command of the Pacific Mail Steamship Oregon, and in 1851 he was transferred to the command of the Golden Gate, of the same line. He continued in this service till 1853. In 1861, upon the special recommendation of Professor A. D. BACHE, he was appointed Hydrographic Inspector of the Coast Survey, in which position he rendered valuable services. In 1874 he was appointed Superintendent of the Coast Survey, to succeed Professor BENJAMIN PIERCE. He was a brother of Admiral THOMAS PATTERSON, of the navy, who recently commanded the Asiatic fleet, and also a brother-in-law of Admiral PORTER. The present efficiency of the United States Coast Survey service is much indebted to the labors of this officer, and the naming of this fine new steamer is a fitting tribute to a worthy man.

INSTRUCTIONS TO DIVISION AND ASSISTANT ENGINEERS RELATIVE TO FIELD NOTES ON SURVEYS FOR THE SOUTH PENNSYLVANIA RAILROAD COMPANY.

First—Enter the names of the Division Engineer, Senior Assistant Engineer in charge of the party, Assistant Engineer at Transit Instrument, Assistant Engineer at Leveling Instrument, Rodmen, Chainmen, Flagman, Axemen, composing the party. Rodmen must make the same notes, also enter the date and place where the work is.

Second—State in the column of Remarks on the first or second page of the book at the beginning of the notes of any survey or levels the letter of the line and where it was begun and where it is to be run to.

Third—The Stakes of all lines must be numbered on the rear face, next to the transit, and must be lettered on the forward face, with the letter of the line. All lines must be lettered.

Fourth—State what Datum the Levels start from or refer to, and if started from a Bench state what Bench and from what authority or book the Elevation was obtained.

Fifth—Enter all notes of Transit or Level fully and distinctly in pencil in the field—if any details or calculations are omitted from haste or sudden storms coming up—make them complete before the day is over, and when required by the Senior Assistant or Division Engineer, they must be recorded in a Record Book the same evening.

Sixth—All field notes must be compared during the day taken, and all Levelers' calculations on turning points must be made by Assistant and Rodman, and compared on the spot and found correct before going forward with the work.

Seventh—Benches must be made at least once in every mile, and oftener if opportunity offers. Levels must be tested on any existing Benches found along the line, and tests made of the accuracy of the old and new work. Benches must not be cut on shade or fruit trees and no unnecessary damage done in clearing the line of sight, offsets must be made to save valuable trees.

Eighth—In passing through inclosed land the Senior Assistant will see that the fences taken down by the party are put up after they pass forward.

Ninth—The Assistant at the Transit must record the names of land owners and the points where boundaries are crossed, and their courses when obtainable.

Tenth—Chiefs of Party must arrange to get the party out and at their work as early as possible in the morning, and keep them employed until the proper hour in the evening. All preparations for the field work must be made by the Senior Assistant and Assistants the previous evening so that no delays may occur in the morning. Dinner will be procured by the Senior Assistant to be eaten in the field when the party is more than one mile from their boarding places.

Boarding expenses paid by any members of the party will be reported to the Senior Assistant and will be repaid by the company at the end of the month.

Eleventh –Senior Assistants will see that the instruments, rods and chains are kept in good order and adjustment by the Assistants; any damage to instruments or rods from want of proper care must be defrayed by the Assistant having the same in charge.

Twelfth—Daily notes of the work done and the date must be entered in this field book every evening.

Thirteenth—Assistant Engineers in charge of the Transit must plot their lines, and Assistants in charge of the Level must, with the aid of their Rodman, make a profile every evening of the line leveled over each day.

Fourteenth—Division and Senior Assistant Engineers will make reports of instruments and stationery on hand at the close of each month, and send them in promptly to the General Office.

Fifteenth—Division Engineers must report any neglect of these instructions to the Chief Assistant Engineer.

OLIVER W. BARNES, Chief Engineer.

ENGINEERING IN THE VANDERBILT UNIVERSITY.

As the last gift of $100,000 by Mr. Wm. H. Vanderbilt to Vanderbilt University has, on account of the special purpose for which it was donated, occasioned a stir, it will be of interest to ascertain what work has been done the last four years, and what it now contemplates doing.

Four years ago the school of engineering was established on like footing with other schools of the University, and Prof. Olin H. Landreth, a graduate of Union College, New York, was placed in charge. Prof. Landreth has shown himself to be a skillful organizer and a careful planner. Five young men have taken the degree of Bachelor of Engineering, and two of them have gone on to the degree of Civil Engineer. Of these two one is a professor in the Industrial University of Arkansas, the other has just been added to the corps of instructors in the new school of manual technology at the Vanderbilt. These graduates are the ripest fruit of this school; but instruction has been given to many others. Last year there were twenty-six young men belonging to this department, and as a rule they are among the most diligent and earnest students of the university.—*Nashville Daily American.*

THE NEW ORLEANS AND NORTH EASTERN is being built rapidly. The West Pearl River bridge is nearly finished; the pivot pier has been safely sunk, although there were many difficulties. The concrete used is made of clean sand and pebble taken from East Pearl River and mixed with cement. Mr. Geo. B. Nicholson is the engineer in charge of the Southern division.

THE APPLETON (WIS.) WATER-WORKS were tested Aug. 21. Eight streams were shown at one time, averaging 140 feet each; a final test was through 1,200 feet of hose 100 feet high. The water is found to be a little hard.

NEWS OF THE WEEK.

THE Erlanger shops will, it is said, be located at Chattanooga, Tenn. They will comprise locomotive and car works, and will be on a large scale.

THE RED WING (MINN.) WATER-WORKS BIDS.—The following bids were opened at the meeting of Council at Red Wing (Minn.), on the 10th inst.:

MacRitchie & Nichol, Chicago, $82,000, with an extra allowance of $3.25 per cubic yard for all rock excavation in pipe trenches.

Dennis Long & Co., everything complete, for $97,057.50.

Fruin & Co., St. Louis, $87,790.

Northwestern Water and Gas Supply Co., Minneapolis (Minn.), $79,500.

Brink & Williams, Red Wing (Minn.), $75,850.

The bid of the Northwestern Water & Gas Supply Co. was unanimously accepted, and the City Attorney and H. H. Harrison, consulting engineer, were appointed a committee to enter into the necessary contract with the said company for the construction of the water-works.

A CHICAGO VIADUCT is proposed. It would start on Lansing street to the Chicago avenue bridge on Halsted street, from West Erie to Branch street; $50,000 has been appropriated by the city.

THE NORTHERN PACIFIC ROAD had both ends joined Aug. 22, thirty miles west of Mullen Tunnel. The engineers who surveyed the Mullan Tunnel and directed its line from both the east and west ends have discovered since the meeting of the hole through the main range, that the lines from the opposite directions came together within two inches, that the grades met within three-quarters of an inch, and the length within half a foot. This is certainly a grand engineering feat, and demonstrates the perfection of modern engineering to such an extent that it has proved to be the most beautiful and interesting of all the sciences. The engineering work of the tunnel has for over a year been under the exclusive direction of F. C. Tucker, resident engineer, and Robert J. Walker and E. G. Bailey, assistant engineers. The work, however, was begun by I. C. Chesebrough nearly two years ago, but the long tunneling through 3,850 feet of the great mountain is a task in its proportion and a monument of the scientific engineering and skill of Chief Engineer J. T. Dodge and his Assistants Tucker, Walker and Bailey, and the Muir Brothers, who were the contractors.

THE SURVEYING CORPS OF THE NEW YORK NORTHERN is at work.

THE MICHIGAN CENTRAL SUSPENSION BRIDGE over the Niagara has the abutments on the American side ready for the iron towers, and those on the Canadian side will be ready this week. The steel for the whole bridge is all on the spot. Trains will run over the finished structure by Dec. 1. To utilize the bridge a short cut is building from Welland, which will be ready by the last of this month.

JAMES RIVER VALLEY RAILROAD.—The directors of the James River Valley Railroad met and organized at Jamestown, Dak., by electing E. P. Wells President; D. McK. Lloyd, Vice-President, and R. E. Wallace, Secretary and Treasurer. Mr. Wells is president of the James River National Bank and Mr. Lloyd is of the banking house of that name here and an owner of extensive iron works at Pittsburgh. The election of these gentlemen gives universal satisfaction and insures the success of the enterprise. Grading will begin at both ends of the road next week and it will be pushed forward as rapidly as possible.

CEMENT DEPOSITS IN CALIFORNIA.—It may not be generally known that there are large deposits of cement in California in the immediate vicinity of railroads, which could be turned into sources of great wealth if a satisfactory process of burning it could be discovered. A few years ago a company undertook the manufacture of cement. They secured a large deposit of the mineral near the town of Santa Cruz, and erected works, spending in all about $75,000; but the material which they manufactured was not of a satisfactory quality, there being some practical difficulties concerning the burning of the rock, which, in its chemical composition differs slightly from that found in the East. The company was finally compelled to cease working, and since then no effort has been made to turn these valuable deposits to account. Experiments, however, are still being carried on, and these have demonstrated that first-class cement can be made out of Santa Cruz rock. A member of a milling firm in this city, who is deeply interested in the matter, recently burned some of the rock in the grate of his office. Unfortunately, he did not watch it closely enough to notice the exact conditions under which the process was conducted, for when he tried the product afterward, he found that he had made a superior article of cement which hardened readily under water. Sinc then he has vainly attempted to repeat the experiment.

THE CUT THROUGH FLORIDA—THE COST OF A TIDEWATER SHIP CANAL ESTIMATED AT $46,000,000.—The meeting of the Board of Directors of the Florida Ship Canal and Transit Company adjourned Aug. 19, after a session of four days. Among those present were the Hon. John C. Brown, President; the Hon. George C. Gorham, Secretary; Gov. Cameron, Senator Mahone, Gen. Grover, and A. W. Jones of Virginia; Townsend Cox, Michael Jacobs, and S. T. Meyer of New York, and Senator Mann and Charles H. Jones of Florida. A report of Chief Engineer Stone was adopted. In the course of his report Gen. Stone says:

I have computed that a tidewater ship canal of sufficient width and depth to allow the passage of two sea-going steamers of the first class without inconvenience can be constructed at a total cost of $46,000,000, as follows: Excavation, $36,000,000; harbors at termini, $4,500,000; engineering, right of way, and contingencies, $5,500,000. The total length of the canal would be 137½ miles, and the highest elevation in crossing the water-shed 143 feet, but this deep cut would be only for a short distance.

The saving of distance to steam vessels between New York and New Orleans would be 500 miles; New Orleans and Liverpool, 412 miles; New York and Pensacola, 600 miles. The gain by avoiding the dangerous passage through the Florida Straits would be very great, and not the least important commercial advantage of the proposed canal would come from the saving on insurance, which is now much heavier for Gulf ports than for South Atlantic ports, and in the expense, which on a large steamer is from $500 to $800 a day.

Gov. Brown expressed the belief that parts of the work would be under contract in 90 days.

ONE OF THE MISSISSIPPI LEVEES CONTRACTORS.—Mr. Hugh Carlisle states that he has finished the Eleslia levee, and will finish the Delta and Bedford by the middle of September. In November he expects to finish the Omega levee. His contract is for 600,000 cubic yards of building.

ITALIANS ARE employed in large numbers on the Michigan and Ohio railroad.

FRANKFORT'S (Ky.) water supply is short. A proposition is now before the City Council to sell the water-works.

[According to Croes' "Statistical Tables," the works date from 1841, and the mode of supply is gravity.]

CONTRACTS LET.—The county commissioners of Vernon (Ind.) have awarded the contracts for the bridge at Och's Fork as follows: For stone work, to Dorsey & Wells, of North Vernon, at $4.40 per cubic yard. The contract for the superstructure was given to the Massillon Bridge Company at $24.50 per foot.

RAILWAYS IN BRITISH COLUMBIA.—VICTORIA, British Columbia, Aug. 19.—The Island Railway contract has been signed, and the syndicate agrees to build the road within three years. They practically secure the only true coal seams yet discovered on this coast.

Sir Alexander Campbell has informed a deputation that the bill passed at the last session of the local House providing for the construction of a railway to the boundary line would not be allowed. Sir Alexander leaves here on Aug. 23. It is said that a perfect understanding between the Dominion and provincial authorities has been arrived at.

WATER-WORKS SURVEYS.—Engineer B. H. Hull of Bridgeport, Ct., is pushing forward as rapidly as possible the surveys for new storage reservoirs for the Bridgeport Hydraulic Co. It has been found necessary to provide additional storage on the Pequonneck River about ten miles from the city. One 100 acre reservoir about located will have a dam 28 ft. high and 400 ft. long, of solid masonry. Another reservoir of 250 acres will have a dam 20 ft. high of solid masonry. The New Milford storage reservoir dam, 39 ft. high from base to overflow, 250 ft. long on top, and now being built after the plans and under the superintendence of Mr. Hull, will be completed about Sept. 15, and will be one of the best dams ever built in Litchfield County.

CLASS IN ELECTRICITY.—The beginning of the next academic year (Sept. 18, 1883) the trustees of Cornell University will receive students who desire to fit themselves to enter the new and constantly extending field of electrical science. While the general studies are mainly those of the departments of civil and mechanical engineering, the special studies of the course embrace the theory of electricity, the construction and testing of telegraph lines, cables and instruments, and of dynamo machines, and the methods of electrical measurement, electrical lighting and the electrical transmission of power.

COMPLETION OF THE PITTSBURG, MCKEESPORT & YOUGHIOGHENY RAILROAD TUNNEL.—This tunnel, or more properly speaking, open cut, was completed on Aug. 19, after one year's work. It is 1,650 ft. in length, double track, with a concrete invert, masonry side walls, and roof of 20 in. iron beams with brick arches sprung between them. The material excavated was mainly furnace slag and cinder, in some cases almost a mass of solid iron, and exceedingly difficult to remove. The purpose of the tunnel was to avoid interfering with the extensive iron works of Jones & Laughlin, under which it passes. The contractors were Messrs. Jones, Drake & Co., the engineers in charge were first Mr. O. H. Balderston, who commenced it, and Mr. T. Low his successor. The cost was about $500,000. On the same day the tunnel was completed 60 miles of the road were opened for freight traffic.

THE COLUMBUS & EASTERN ROAD is now being laid with track. Mr. James E. Redfield has been lately in Columbus, making arrangements with contractors.

CHICAGO REMUNERATING RAILROAD.—The Secretary of State on the 10th licensed the Chicago Remunerating Railway Company with a capital stock of $1,000,000. The object of this company is to construct and operate an elevated railroad from Evanston and out of the city of Chicago to South Chicago and other towns, cities, or villages. The incorporators are John J. Richards, W. Rumsey and George H. Leonard.

PINE CREEK & SUSQUEHANNA RAILWAY COMPANY, narrow-gauge road, chartered at Harrisburg on the 10th. The capital is $400,000. The line extends from Pike Mills, Potter County, to Westport, Clinton County, a distance of 40 miles. The principal office is at Elkand, Tioga County. Among the Directors are Thomas C. Platt, William C. Sheldon and George R. Blanchard.

THE NASHVILLE, CHATTANOOGA & ST. LOUIS RAILWAY has ordered the engineer to make surveys with a view to extend the McMinnville Branch to the Bon Air coal fields. These fields contain enough coal to supply the South for years, and the extension will tend to cheapen the price. The Sparta extension from Rock Island to Sparta will be completed this Fall, also the bridge over Carey Fork, the highest railroad bridge in the United States.

THE NATIONAL SEWER PIPE CO.—The organization of the National Sewer Pipe Co., under the corporation laws of Ohio, has been effected and charter obtained. Its capital stock is $100,000. Its main office is Wellsville, Columbiana County, O. N. U. Walker, President; W. F. Denspaugh, Secretary; Hugh McMahan, Treasurer. The company has control of nine sewer pipe works, which will enable them to fill orders promptly for large quantities with the best class of goods. The facilities of this company are greater than those of any other ever formed in the United States. The officers are men long acquainted with the trade, which, with railroad facilities and their line of boats on the Ohio River, gives them great advantages. They propose furnishing goods, in large or small quantities, in all the American markets. Their goods embrace sewer pipe, terra cotta flues, firebrick and clay products.

THE ELECTRICAL CONDUIT CONSTRUCTION COMPANY was incorporated last week. Its purpose is to make and sell electrical conduits and underground conductors of electricity. Its corporators are D. N. Hurlbut, of Illinois, and S. F. Kneeland, Charles A. Brown, W. H. Fairbank, A. B. Chandler, H. W. Pope and Elisha Gray. The capital stock of the company is fixed at $1,000,000, and its shares at $10 each.

THE CHICAGO CUSTOM-HOUSE is making rapid progress to completion, and will be ready for occupancy Nov. 1.

THE NEW YORK, DANBURY & BOSTON R. R. CO., with a capital stock of $3,000,000, was organized last week in the office of W. R. Bergholz, No. 15 Cortlandt street, New York. The line of the road will extend from the Harlem River opposite Second avenue, to Danbury, Conn., where connection will be made with the New England system to Boston and through the North. The road from the Harlem River to Port Chester will be newly constructed. From that point, however, to Richfield the work done by the New York and Richfield Company, which consists of grading and masonry and represents $400,000 in money, will be utilized. Satisfactory arrangements between the directors of the two companies have been concluded, and the work will be commenced at once. Among the incorporators of the new organization are a large number of wealthy men. The incorporators are W. R. Bergholz, who will probably be the chief engineer of the company; P. C. Lounsbury, of Richfield; Henry R. McHarg, the banker; Joseph W. Ogden, the banker, of No. 2 Wall street; Dennis C. Wilcox, of this city; William E. Russell, of this city; Thomas Nast, the artist; John M. Masterton, of East Chester; J. C. Short, of this city; J. A. Bostwick, Treasurer of the Standard Oil Company; Christian Meyer, of this city; H. W. Ford, President of the Bank of the Republic; J. L. Macauley, of this city; George W. Quintard, of Port Chester; Charles J. Osborne, the well-known broker; ex-Gov. Pliny Jewell, of Hartford; D. H. McAlpine, the tobacco manufacturer; George W. Bartholomew, of Hartford, President of the Charter Oak Life Insurance Company; R. N. Hazard, President of the American Loan and Trust Company; William P. Abendroth, of Port Chester; H. M. Flagler, President of the Standard Oil Company; Elwood Birdsall, of Port Chester; Thomas T. Buckley, of New York, and Thomas L. Rushmore, Mamaroneck. The incorporators elected the following Directors: Christian Meyer, J. L. Macauley, G. W. Quintard, C. J. Osborne, Pliny Jewell, D. C. McAlpine, H. W. Ford, G. W. Bartholomew, R. N. Hazard, J. W. Ogden, E. Birdsall, W. R. Bergholz and W. P. Abendroth.

A BRIDGE ACROSS THE ST. JOHN RIVER, N. B.—The St. John Bridge Company contracted with the Dominion Bridge Company, of Montreal, for building a bridge across the falls. It will be 650 ft. in length, the main span 426 ft., and must be finished by Aug., 1884.

THE CANADIAN PACIFIC wants an Atlantic outlet in winter, and it is thought that arrangements will be made with the St. Johnsbury, Lake Champlain & Portland.

NO MORE LONG RAILROAD BUILDING.—After the completion of the Northern Pacific, this month, there will remain but a single road which will construct a considerable additional mileage this year, namely, the New York, West Shore & Buffalo. This fact will release a large amount of capital, which will not long lie idle.

A NORTHERN OUTLET FOR THE GULF, COLORADO AND SANTE FE is wanted. Mr. Temple, chief engineer of the road, and other officials, were lately in St. Louis. It is thought the road will be extended from Dallas through Northeastern Texas, Arkansas and Missouri, to connect with Chicago, Burlington & Quincy.

RAILROAD CONTRACT.—The contract for building the extension of the Detroit, Mackinac and Marquette railroad, from Marquette to the iron mining region of Lake Superior, was let Saturday to Craigie, Rafferty & Yeomans of Buffalo, N. Y. Work is to begin in ten days, and the firm give bonds under heavy penalty to complete the road on or before February 1, 1884.

A TUNNEL IS TO BE BORED by the Pleasant Valley and Lake Canal Company of Colorado. It is to be cut through Bingham Mountain, to be 1,500 ft. in length and 6 × 6 ft. The cost will be $20,000. It must be finished May 1, 1884, according to the contract terms.

GRADING THE SCHUYLKILL VALLEY BRANCH.—READING, Aug. 21.—The contracts for the grading of the Schuylkill Valley branch of the Pennsylvania Railroad Company, from Monocacy to Reading, a distance of eleven miles, were awarded this morning to the following parties: From Monocacy to Robeson, a distance of four miles, to Keller, Bush & Cressent, of Slatington; from Robeson, to Naomi, three miles, to William Hamman, of Reading, and from Naomi to Reading, four miles, to Nolan & O'Reilly, of Reading. The work on the portion of the line just allotted is to be prosecuted vigorously. Bid for track-laying in Reading will be asked for very shortly. The new iron bridge to span the Schuylkill at this point will be built as soon as possible.

NEW RAILROAD COMPANY.—The Ottawa, Osage City and Council Grove Railroad Company was incorporated at Topeka (Kan.), on Aug. 16. The capital is $1,500,000.

TWO NEW ROADS.—Ground was broken on the Pittsburgh East End Aug. 16. Chief Engineer Roberts had charge. Contracts have not, however, been let, owing to injunctions. The New Castle road runs to Middlesex, 16 miles. W. W. Reed is the contractor for building. It has been surveyed by a corps of engineers under Major Negley.

THE BRIDGE AT SPRING CREEK, near Shasta, on the California & Oregon Railroad, is completed.

THE CAPE COD CANAL COMPANY are busy with their preliminary work. The western terminus will be at the mouth of Monument River, and the eastern on the southerly side of Sagamore Hill.

ENGINEERS are locating a road from Helena (M. T.), to connect the towns and mining camps as far south as Wickes.

A PHILADELPHIA CABLE MOTOR COMPANY.—HARRISBURG, Aug. 22.—A charter was granted to-day to the Traction Company, of Philadelphia, with a capital of $5,000,000. The directors are William H. Kemble, Peter A. B. Widener, William L. Elkins, George R. Yarrow, George W. Elkins and George D. Widener. The directors own all the stock. The object of the company is the construction of cable motors and other appliances for traction of passenger railways and the furnishing of the same. A charter was also issued to the same parties for a corporation to be known as the Philadelphia Patent Right Company, for the display of patent rights. Capital, $150,000.

THE CURTIS REGULATOR.—The Foreign Exhibition Building, in Boston, has recently been sup-

plied with a 5-in. *Curtis Pressure Regulator* in order to utilize the exhaust steam for heating purposes.

A NEW LINE FROM CHICAGO TO KANSAS CITY has been surveyed. Two branches are to be made in Missouri, making in all 600 miles of road. J. S. Thompson, of Chicago, the president, is in New York making contracts.

A SURVEY OF A ROAD from Alamas to Culiacan (Mex.) is being made.

THE MARSHALL (MO.) GAS-WORKS are nearly completed.

FAILURE OF A WATER-PIPE MANUFACTURER.—Silas Merchant, of Cleveland, has failed. Liabilities are placed at $100,000.

THE AMERICAN MIDLAND RAILROAD has filed articles at Indianapolis, increasing its capital.

A LIBEL SUIT FOR $50,000 damages has been begun in the St. Louis courts by Mr. Andrew J. Chaphe, chief engineer at the water-works, against E. C. Slevin and the *Post Dispatch*.

THE GALVESTON, HARRISBURG & SAN ANTONIO will soon send an engineering corps to survey the route for a branch from Houston to connect with the Texas and Pacific.

GEORGIA'S NEW CAPITOL.—ATLANTA, Ga., Aug 15.—To-day the House passed a bill appropriating $1,000,000 for the building of a new Capitol. It will take five or six years to complete the work. The bill will doubtless pass the Senate with minor amendments if any.

A WATER FAMINE.—GALVESTON, Texas, Aug 17.—This city is on the verge of a water famine. The cisterns are drained, the gardens are dried up, and the effect of the drought is to be plainly seen in the poverty of the vegetable market. For a week past many persons have been depending upon the liberality of their neighbors for water enough to drink, having exhausted their own supplies. Now most of those who were well provided at the beginning of the dry season are almost completely without a supply. An indication of the extreme want to which some persons are driven is found in a notice posted in front of one of the best known and most popular restaurants in the city, which reads; "Closed until it rains." A slight rain has fallen to day, but not enough to change the situation.

N. Y. & PHIL. MANUFACTURES.—The cities of New York and Philadelphia, it appears, now represent an enormous manufacturing interest closely approaching $500,000,000 each, of which the greater part in both cities, and nearly all in New York, is the growth of the last twenty-five years. New York has especially advanced within the last ten years, and its industries are conspicuous by their commercial value. It appears that in the latter city, in 1880, 11,339 establishments, employing 227,262 persons, produced a total value of $472,926,437, while in Philadelphia, in 1882, 11,841 establishments, employing 241,443 persons, produced a total value of $475,814.402. As will be seen, an interval of more than two years elapsed between the respective enumerations. This has, of course, to be taken into account in any comparison of the relative positions of the two cities in which numerical results are considered.—*Bradstreets.*

THE BARTHOLDI STATUE.—The whole cost of laying the base will be $51,000 or $52,000. The contractor will furnish all the material except the cement. The foundation is to be of concrete composed of cement, sand, and broken stones. It will be 93 ft. square at the bottom, 70 ft. at the top, and 48 ft. 8 in. high. It will begin at the bottom of the excavation, 15 ft. deep, and its height above low water mark will be 66 ft. 8 in. The pedestal, which will rise to an altitude of 112 ft., will be about 67 ft. square at the base and 40 at the top. The foundation is to be completed Nov. 15, and the contractor is to leave his hoisting plant for the future operations of the committee.

WALLING IN FAIR'S LOT.—George D. Nagle, has received a $15,000 contract for a granite wall around J. G. Fair's lot on California, Mason and Sacramento streets, San Francisco.

BOSTON POST-OFFICE.—McNeil Bros. are the lowest bidders, at $24,882, for the joiner work and wood flooring.

ARTESIAN WELL AT OCEAN GROVE.—Water was reached on the 10th, at a depth of 892 ft., and flowing 43 gallons per minute.

HARRISBURG & SOUTHWESTERN R. R.—The capital stock is $5,000,000. Length, 90 miles. Robert H. Sayre, of Bethlehem, is President, and Francis J. Gowen, Philadelphia, Edward V. Lansdale, Philadelphia, Charles H. Quarles, Philadelphia, John M. Lamberton, New York, Charles A. Pool, New York, and Frank Irish, New York, Directors. This will be a branch of the Vanderbilt road from Harrisburg to Pittsburg.

DREDGING IN ROYAL RIVER, MAINE.—Augustus R. Wright, of Portland, Me., was the only bidder for dredging Royal River, Me., and the contract was awarded to him at his contract price, 26c. per cubic yard measured in scows.

LIGHT-HOUSE CONTRACTS.—Bids were opened at the Treasurer Department, Aug. 16, for the construction of light-houses at Cape San Blas and Sanibel Island, Florida. The Phœnix Iron Company, of Trenton, N. J., made the lowest bid, and will probably receive the contract.

MATERIAL FOR IMPROVEMENT OF CAPE FEAR RIVER.—The following is an abstract of the proposals received for furnishing material for the improvement of Cape Fear River, opened August 2, 1883:

6,000 lbs. ratline, per lb., Loud, Claridge & Co., Baltimore, Md., 10.97c.; Hanson & Smith, Wilmington, N. C., 10.5c.; Ross & Lara, Wilmington, 12c.; Nathaniel Jacobi, Wilmington, 10.5c.; John C. Springer, 10½c. Awarded to John C. Springer.

6,000 lbs. spun yarn, per lb., Loud, Claridge & Co., 10.47c.; Hanson & Smith, 9.5c.; Ross & Lara, 12c.; Nathaniel Jacobi, 9.5c.; John C. Springer, 9.5c. Awarded to John C. Springer.

Brush, per cord, Ross & Lara, $3.60. Awarded contract.

C ne, per cord, F. Rheinstein, $2.85; Ross & Lara, $2.60; W. H. Robbins, $3.15. Awarded to Ross & Lara.

3,000 tons stone, Ross & Lara, $3.22½; George Z. French, $1.75. No award has been made.

IMPROVING PASSAIC RIVER.—The following is an abstract of the bids received for dredging in Passaic River, opened July 27:

Morris & Cummings Dredging Company, New York. $4.50 per cubic yard.

Elijah Brainard, New York, $1.88 per cubic yard.

William E. Clark, Rahway, N. J., 53 cents per cubic yard.

Frank Pidgeon, Jr., New York, 38¾ cents per cubic yard.

Hartford Dredging Company, Hartford, Conn., 68¾ cents per cubic yard.

The contract has been awarded to Frank Pidgeon, Jr., of New York.

DREDGING IN GOWANUS BAY, N. Y.—The following is an abstract of the bids received for dredging in Gowanus Bay, N. Y., opened July 30, 1883:

John H. Haywood, New York, 18 cents per yard.

Henry Dubois' Sons, New York, 24 cents per yard.

Elijah Brainard, New York, 18 cents per yard.

Thomas H. Benton, Elizabeth, N. J., 21½ cents per yard.

Augustus R. Wright, Portland, Me., 32 cents per yard.

W. M. Beard, Brooklyn, 22 cents per yard.

Morris & Cummings Dredging Company, New York, 27 cents per yard.

The contract has been awarded to Elijah Brainard, New York.

BUILDING RETAINING AND PIER WALLS, WOOD'S HOLL, MASS.—The following are the bids received for building retaining and pier walls in the harbor of refuge at Wood's Holl, Mass., opened July 6, 1883:

Isaac A. Sylvester, Atlantic, Mass., $45,270; Charles H. Edwards, Boston, Mass., $53 595; Frederick K. Ballow, Mystic Bridge, Conn., informal, $58,006; Joseph Ross, Ipswich, Mass., $68,087.50; C. Y. Derry and James Burr, Boston, Mass., $71.050; John F. Hamiltion, Portland, Me., $73,600; Hiram W. Phillips, Quincy Point, Mass., $89,481.

The contract has been awarded to Isaac A. Sylvester, Atlantic, Mass.

REMOVING WRECK OF NASCATELLE IN CHESAPEAKE BAY.—The following is an abstract of the bids received for removing the wreck of the Nascatelle in Chesapeake Bay, opened July 24, 1883:

Edward R. Lowe, New York, $7,000, and will pay $2,000 for vessel and cargo.

Wm. E. Chapman, Brooklyn, N. Y., $5,890; George W. Townsend, Boston, Mass., $3,000; E. M. Stoddard, Norfolk, Va., $1,000.

Award made to E. M. Stoddard.

BULL'S IRON & STEEL CO.—A company with a capital of $10,000,000, divided into 100,000 shares of $100 each, has filed its certificate of incorporation at the County Clerk's office. The company is known as Bull's International Iron and Steel Company. The Trustees as named are Senator Henry W. Blair and ex-Senator Aaron H. Cragin, of New-Hampshire, the latter at present a resident of this city; Henry G. Bicknel, Edgar B. Kenyon, James Turner, Benjamin M. Plumb, Frederick M. Kelly, and Benjamin W. King, of this city, and Charles M. Gormley, of Pittsburgh, Penn. The only incorporator not included in the Board of Trustees is Lyman P. Converse. When asked last evening what the purposes and plans of the gigantic company were Senator Blair, who is here as chairman of the committee investigating the difficulties between capital and labor, said that he was not sufficiently well informed about them to make any intelligent statement. According to its certificate, they are "to acquire patents relating to the manufacture of iron and steel, coke and gas, and the erection, occupation, and maintenance of works, furnaces, or mills for such manufacturing." The purpose, as set forth by one of the projectors and heavy stockholders in the company, Dr. B. W. King, is the development of a patent process for manufacturing iron and steel at a great reduction from the present cost. The parent projector of the scheme is Benjamin M. Plumb, of this city and Brooklyn, who is described as "a professional organizer of enterprises," and who is the President of the New York and St. Paul Stove Company and the Waterproof Fabric Company, and is also interested in the American Railway Signal Company.

THE KINGSTON, PA., COAL COMPANY.—A charter was issued at Harrisburg on the 9th, to the Kingston Coal Company, of Kingston, Luzerne County, with $1,000,000 capital. The stockholders are Thomas Beaver, Geo. F. Geisinger, Danville; Daniel Edwards, Theodore L. Newell, Kingston; Clara W. Dwight, Edmund P. Dwight, and John C. Bullitt, Philadelphia.

ASCENDING MT. HOOD, JULY 12.—Readings of barometer: Silverton, 300 feet; Sandy, 1,025 feet; Toll-gate, 2,200 feet; foot of Laurel Hill, 2,765 feet; top of Laurel Hill, 5.650 feet; Cathedral Park, 6,300 feet; timber line, 6,500 feet; base of crater rock, 10,850 feet; north base of crater rock, 11,125 feet.—*Silverton, Or., Appeal, July* 28.

THE BURLINGTON, CEDAR RAPIDS AND NORTHERN RAILROAD is contemplating to build an extension to its Pacific Division, to run from Worthington, Minn., to some point in Dakota, the terminus of which has not yet been determined. Operations are to begin early this fall.

WATER METERS FOR BOSTON.—The Water Board has decided on the adopting of a measurement system by meters for the use of Boston. The board believes that, with the introduction of the meter system throughout the city, a great saving in the water rates will be obtained. It is intended to introduce about 3,000 meters in the city before the end of the year.

SUITS TO RECOVER SURETY BONDS.—Chas. O. Gregory, contractor, has entered an action for $100,000 against the Halifax & Cape Breton Railroad Company, and another for a like amount against the Canada Improvement Company. The actions are to recover surety bonds in the hands of defendants.

IRON AND METAL MARKETS.

PHILADELPHIA, AUG. 24.

The Eastern Pennsylvania pig iron market continues quiet and dull. Sales are for the most part in 100 ton lots of Foundry, and 200 and 300 ton lots of Forge iron. Prices range from $19.50@$21 for No. 2. This week's sales have been as high as $23 for No. 1. Furnace quotations for Forge are $17@$17.50. Twelve per cent. Spiegeleisen sold at $25.50, 1,000 tons. Scotch iron is moving in trifling lots. Two or three sales of Muck bars have been made at $34. Small lots of manufactured iron sell at 2.15@2.20c.; large lots can be had at 2.10c. Nothing unusual has taken place. Inquiries are encouraging for construction iron, plate and tank, but business is light. Bridge work is wanted for November and December. Old rails are held firmly at $23.50 asked, $23 offered for tees; double heads, $25 offered. Crop ends are $23. Cargo scrap, $22.50. Very little will be done this month. Buyers look for a weakening in prices, but manufacturers and brokers are confident that no reduction can be made, and look for an upward tendency when fall demand, which is being withheld, is presented.

PITTSBURGH.

The iron market continues quiet, but pig iron is firmer. Best Foundry, $20@$21; No. 2, $18@$20. Sales of a few hundred ton lots have been made at 50c. under these figures. Bessemer pig is selling slowly at $21 in small lots; large lots could sell at $20. Gray Forge is selling between $17@$18, but heavy requirements are not placed. Old rails are quoted at $23@$24; no sales. A few small orders for steel rails were placed at $38.50. Wrought scrap sold at $24 for best, and $23 for No. 2. Merchant iron is selling at 1.90c.; large orders can be placed at 1.80c. Nails are $2.90 in car-load lots. Builders are purchasing in small lots and look for better terms as soon as stocks accumulate.

CHICAGO.

Charcoal irons have advanced 50c. Southern irons are in improving demand for machine and agricultural implement work. A few hundred tons of Scotch iron have sold during the past week at $20@28.50. Domestic iron is quiet and firm. Late orders are not being placed. Manufactured iron shows a little strength, but trade is moderate. Structural iron is in good request. Beams, 3.60c.; channels, 3.80c. Galvanized iron for building purposes is active; large orders have been placed. Nails are quiet at $3.15 in small lots and $3.05 in car-load lots. Tin plates are unchanged. Pig lead, 4.05c.; sales, 400 tons. Ingot copper, 15¼c. for Lake. A fair trade in steel is reported. There is nothing new in steel rails. The hardware market has improved under increasing orders. Steel goods are 50 per cent. off list.